



Endovascular Thrombectomy (EVT)

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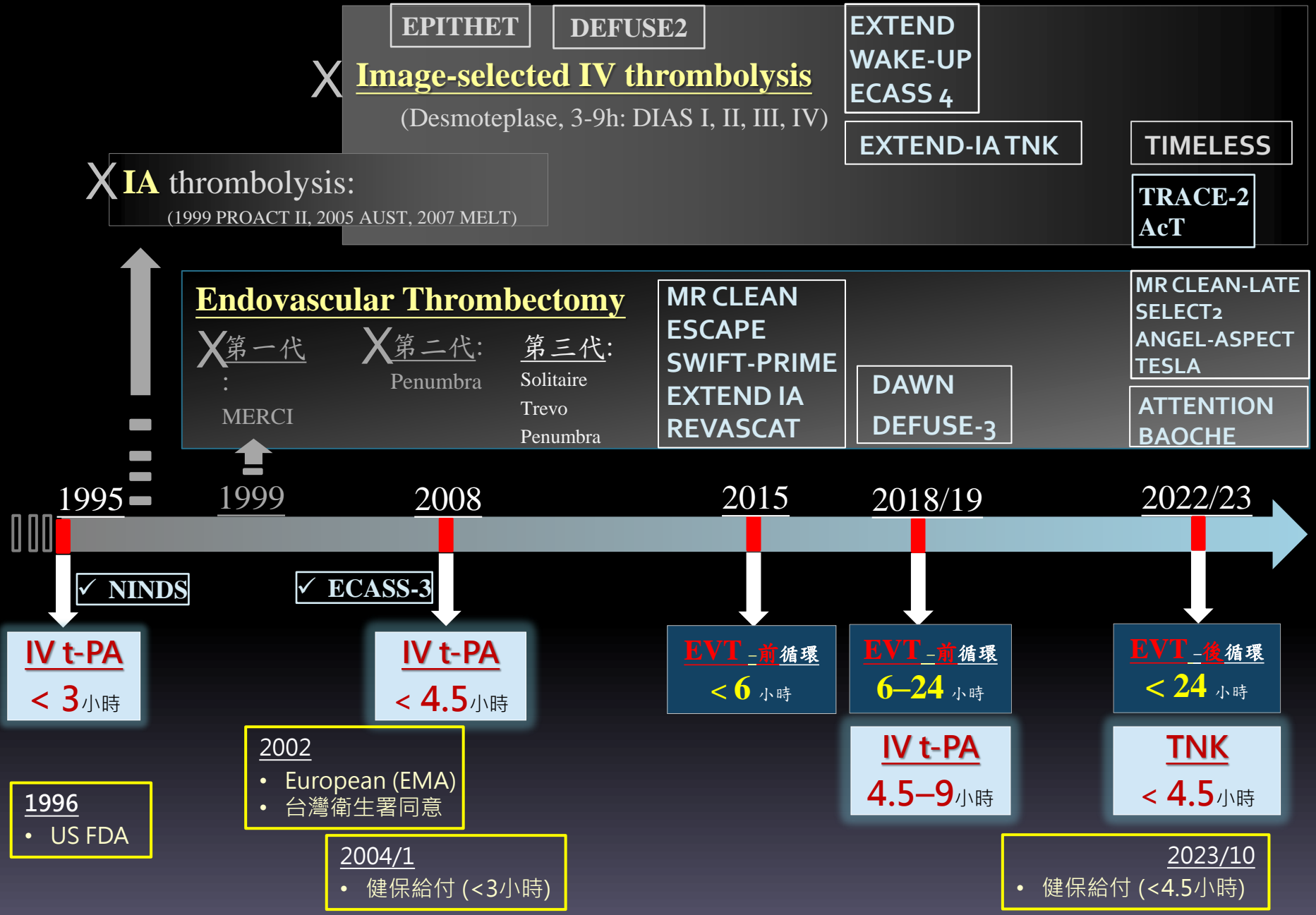


Image-selected IV thrombolysis
 (Desmoteplase, 3-9h: DIAS I, II, III, IV)

IA thrombolysis:
 (1999 PROACT II, 2005 AUST, 2007 MELT)

Endovascular Thrombectomy

第一代: MERCI

第二代: Penumbra

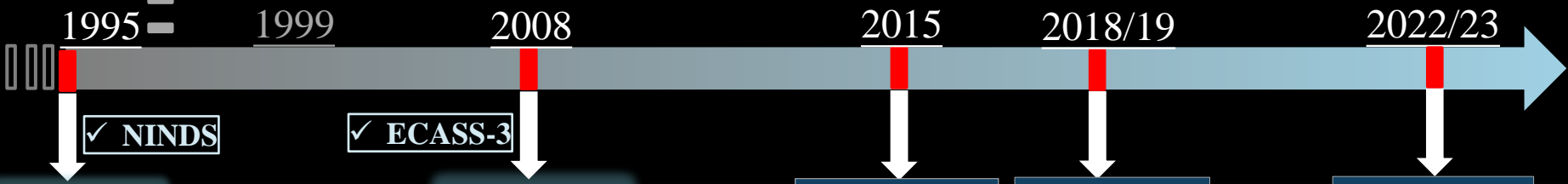
第三代: Solitaire, Trevo, Penumbra

MR CLEAN
 ESCAPE
 SWIFT-PRIME
 EXTEND IA
 REVASCAT

DAWN
 DEFUSE-3

MR CLEAN-LATE
 SELECT2
 ANGEL-ASPECT
 TESLA

ATTENTION
 BAOCHE



IV t-PA
 < 3 小時

IV t-PA
 < 4.5 小時

EVT - 前循環
 < 6 小時

EVT - 前循環
 6-24 小時

EVT - 後循環
 < 24 小時

1996
 • US FDA

2002
 • European (EMA)
 • 台灣衛生署同意

2004/1
 • 健保給付 (<3 小時)

IV t-PA
 4.5-9 小時

TNK
 < 4.5 小時

2023/10
 • 健保給付 (<4.5 小時)

Acute Ischemic stroke

< 4.5 h

Fit IV t-PA criteria?

Yes

IV t-PA

Yes

4.5-9 h or Wake-up

Fit EXTEND or WAKEUP criteria?

4.5 - 6 h

- CTA or MRA

EVT criteria:

- Large artery occlusion
- NIHSS ≥ 6
- ASPECTS score ≥ 6
- \pm Perfusion

- CTA or MRA

No

- NIHSS ≥ 6

→ CTA or MRA

No

6 - 24 h

- NIHSS ≥ 6
- CTA/CTP
or MRA/MRP

EVT criteria:

- DAWN criteria
- DEFUSE-3 criteria

Fit EVT criteria?

Yes

EV Thrombectomy

Guidelines

- 2019 ASA/AHA guideline
- 2008 台灣腦中風防治指引
- 2013 靜脈血栓溶解劑治療急性缺血性腦中風指引
- 2019 急性缺血中風靜脈血栓溶解治療指引
- 2019 台灣腦中風學會急性缺血中風動脈內血栓移除治療指引
- 2023 台灣腦中風學會急性缺血中風動脈內血栓移除治療指引

CLASS OF RECOMMENDATION

CLASS I	(STRONG)	Benefit >>> Risk
CLASS IIa	(MODERATE)	Benefit >> Risk
CLASS IIb	(WEAK)	Benefit \geq Risk
CLASS III: No Benefit	(MODERATE)	Benefit = Risk
CLASS III: Harm	(STRONG)	Risk > Benefit

LEVEL OF EVIDENCE

LEVEL A

LEVEL B-R **Randomized**

LEVEL B-NR **Nonrandomized**

LEVEL C-LD **Limited Data**

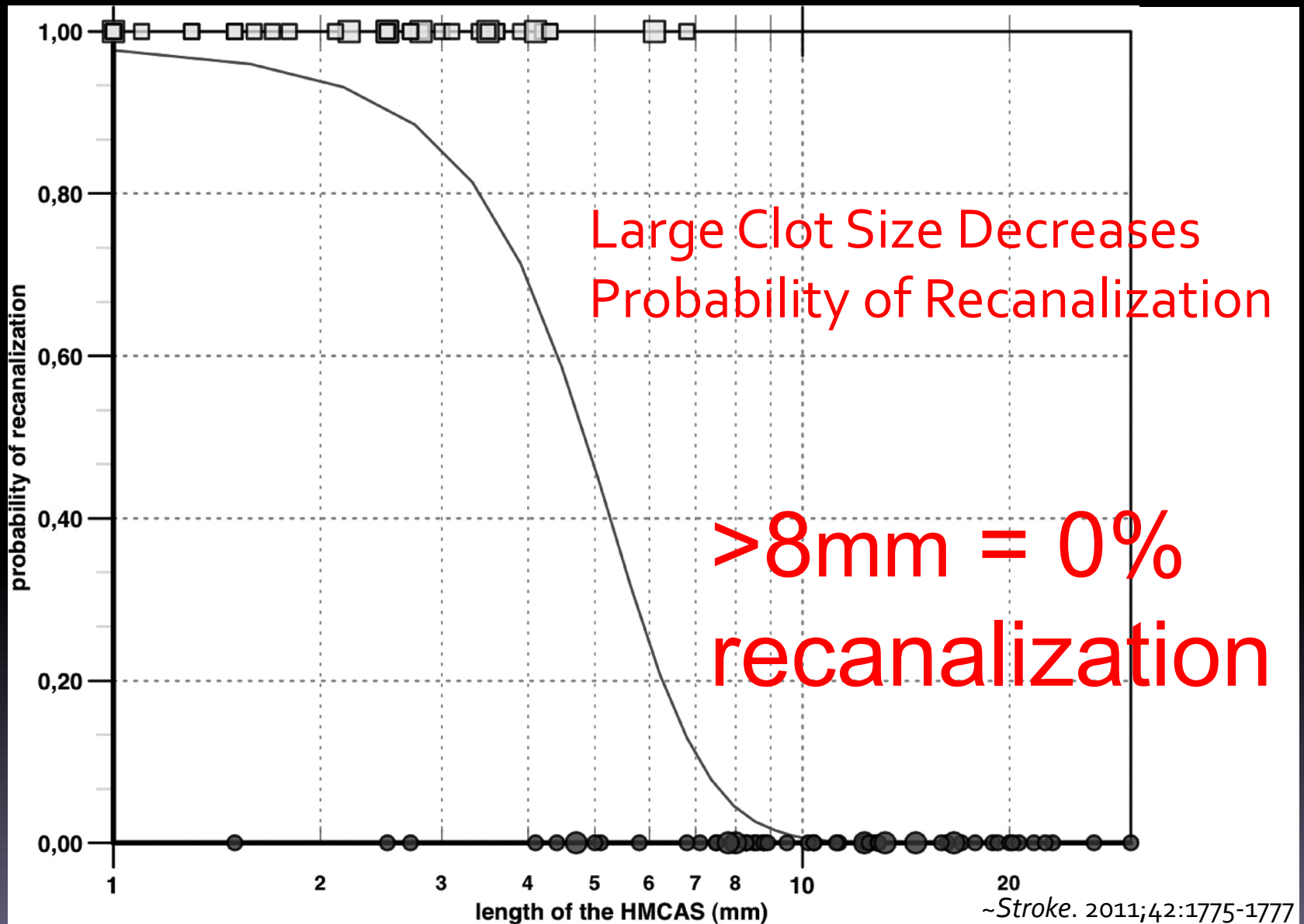
LEVEL C-EO **Expert Opinion**



Reperfusion therapy:

1. IV t-PA
2. Endovascular Thrombectomy (EVT)
(Intra-arterial thrombectomy,
mechanical thrombectomy)

Why is IV t-PA not enough?



EVT 健保規定

1. 前循環、後循環 < 24 小時。
2. 影像診斷為顱內大動脈阻塞，包括ICA, MCA(M1, M2), ACA, VA 和 BA。
3. NIHSS : 6 - 30。
4. 前循環若於發作後8小時至24小時執行，申報時須於病歷檢附影像報告(CTP、MRP或CTA collaterals)備查。
5. 禁忌症：(1)蜘蛛網膜下腔出血 (2)腦內出血 (3)硬腦膜下出血/顱內出血

EVT 收案條件 - Early time window

腦中風學會

健保規範	2019 AHA/ASA	COR	LOE
無限制	年齡 ≥ 18 歲	I	A
< 6 小時	< 6 小時		
NIHSS: 6-30	NIHSS: ≥ 6		
無	ASPECTS ≥ 6		
無	Pre-stroke mRS ≤ 1		
ICA or MCA(M1, M2)	ICA or MCA(M1)	IIb	B-R
	MCA(M2, M3)		C-LD
ACA, VA, BA	ACA, VA, BA, PCA	IIb	C-LD

EVT 收案條件 - Early time window

健保規範	2019 AHA/ASA	COR	LOE
無限制	年齡 ≥ 18 歲	I	A
< 6 小時	< 6 小時	IIb	B-R
NIHSS: 6-30	NIHSS: < 6	IIb	B-R
無	ASPECTS < 6	IIb	B-R
無	Pre-stroke mRS > 1	IIb	B-R
ICA or MCA(M1, M2)	ICA or MCA(M1)	IIb	B-R
	MCA(M2, M3)		
ACA, VA, BA	ACA, VA, BA, PCA		

EVT 收案條件 - Late time window

健保規範

2019 AHA/ASA

COR LOE

前循環

< 24 小時

6-16 小時
(DAWN and DEFUSE-3 criteria)

I

A

16-24 小時
(DAWN criteria)

IIa

B-R

後循環 : VA, BA

< 24 小時

< **6** 小時

IIb

C-LD

2023台灣腦中風學會指引

術前影像檢查

- 中風發病24小時內的病人在進行動脈內血栓移除治療 EVT之前，建議以CTA/CTP 或MRI DWI來確認有符合臨床症狀的大血管阻塞。
- 對於急性缺血性腦中風患者懷疑顱內大動脈阻塞時，腎功能病史不明或未檢查血清肌酸酐 (creatinine)結果前，直接進行CTA檢查是合理的。

I

A

Ila

B-NR

2023台灣腦中風學會指引- **Late** time window

前循環腦中風**6-24**小時內

- 大血管阻塞(MCAM1或ICA) ，符合DEFUSE 3或DAWN試驗的條件，在臨床醫師的判斷下，得進行動脈內血栓移除治療。
- 符合MR CLEAN-LATE試驗的條件，使用CTA影像確定有側枝循環，可以考慮動脈內血栓移除治療，但可能增加症狀性腦出血的風險。
- CT ASPECT 3-5，或灌注影像CTP/MRP分析或MRI DWI診斷infarct core 50-100毫升，若無腫塊效應(mass effect)，可以考慮動脈內血栓移除治療，但可能增加腦出血的風險。

I

A

IIb

B-R

IIb

B-R

2023台灣腦中風學會指引- **Late** time window

後循環腦中風 < 24小時內

- 中風症狀發作12小時內之基底動脈阻塞，符合ATTENTION或BOCOCHE試驗的條件，NIHSS \geq 10的患者，建議進行動脈內血栓移除治療以改善三個月後之功能。
- 中風症狀發作12-24小時內之基底動脈阻塞，符合BAOCOCHE試驗的條件，NIHSS \geq 6，MRI DWI或CTA影像PC ASPECT \geq 6，進行動脈內血栓移除治療是合理的。
- 中風症狀發作24小時內且單獨後大腦動脈阻塞 (PCA occlusion) 的患者，可以考慮動脈內血栓移除治療，但功能預後仍不明確

I

A

IIb

B-R

IIb

B-NR

Endovascular thrombectomy

2019 AHA/ASA

Use of **stent retrievers**:

Solitaire™, Trevo™, Revive™

COR

LOE

I

A

Direct aspiration: Penumbra™

I

B-R

Achieve a modified Thrombolysis in Cerebral Infarction (mTICI) 2b/3

I

A

Use of a proximal balloon guide catheter or a large-bore distal-access catheter

IIa

C-LD

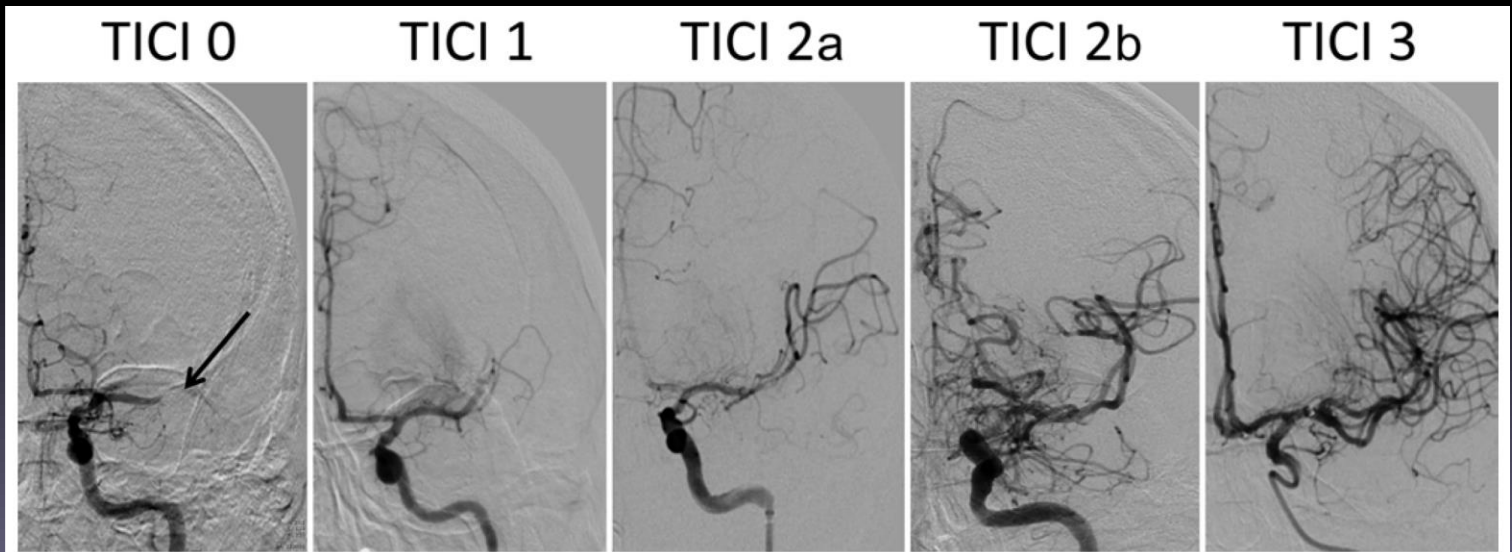
Tandem occlusions: both IC and EC

IIb

B-R

mTICI score

- Grade **0**: no perfusion
- Grade **1**: limited antegrade reperfusion
- Grade **2**
 - **2a**: reperfusion of **< 50%** ischemic territory
 - **2b**: reperfusion of **$\geq 50%$** ischemic territory
- Grade **3**: complete antegrade reperfusion



EVT 收案條件

腦中風學會

COR

LOE

年齡 ≥ 80 歲

預期剩餘生命 < 1 年者

嚴重系統性疾病

腎功能異常 ($Cre > 2$ mg/dL)

2週內有接受過重大手術

血小板偏低 ($< 100K/mm^3$)

48小時內曾使用 **NOAC**

頑強性高血壓，經積極的治療(靜脈給藥)仍無法改善

血糖過高或過低 (> 400 mg/dL 或 < 50 mg/dL)

懷孕病人

增加腦出血風險的病人

IIb

B-R

Endovascular thrombectomy

2019 AHA/ASA

COR LOE

Observation after IV alteplase

III: Harm

B-R

IV glycoprotein IIb/IIIa inhibitors

IIb

C-
LD

Salvage with IA fibrinolysis

IIb

C-
LD

2023台灣腦中風學會指引

血栓移除術中之鎮靜與麻醉的建議

- 對於執行EVT的患者，依據病人整體狀況，和各醫療院所人力配置，選擇適當的鎮靜麻醉或全身麻醉術式是合理的。
- 不論何種麻醉術式，維持EVT術中血壓穩定是合理的。

IIa

B-R

IIa

B-NR

Endovascular thrombectomy

2019 AHA/ASA

	COR	LOE
Receive IV t-PA first if eligible	I	A
Select conscious sedation or general anesthesia	IIa	B-R
Keep BP \leq 180/105 mmHg for 24 hrs after procedure	IIa	B-NR
Keep BP \leq 180/105 mmHg with successful reperfusion.	IIb	B-NR

IV t-PA first

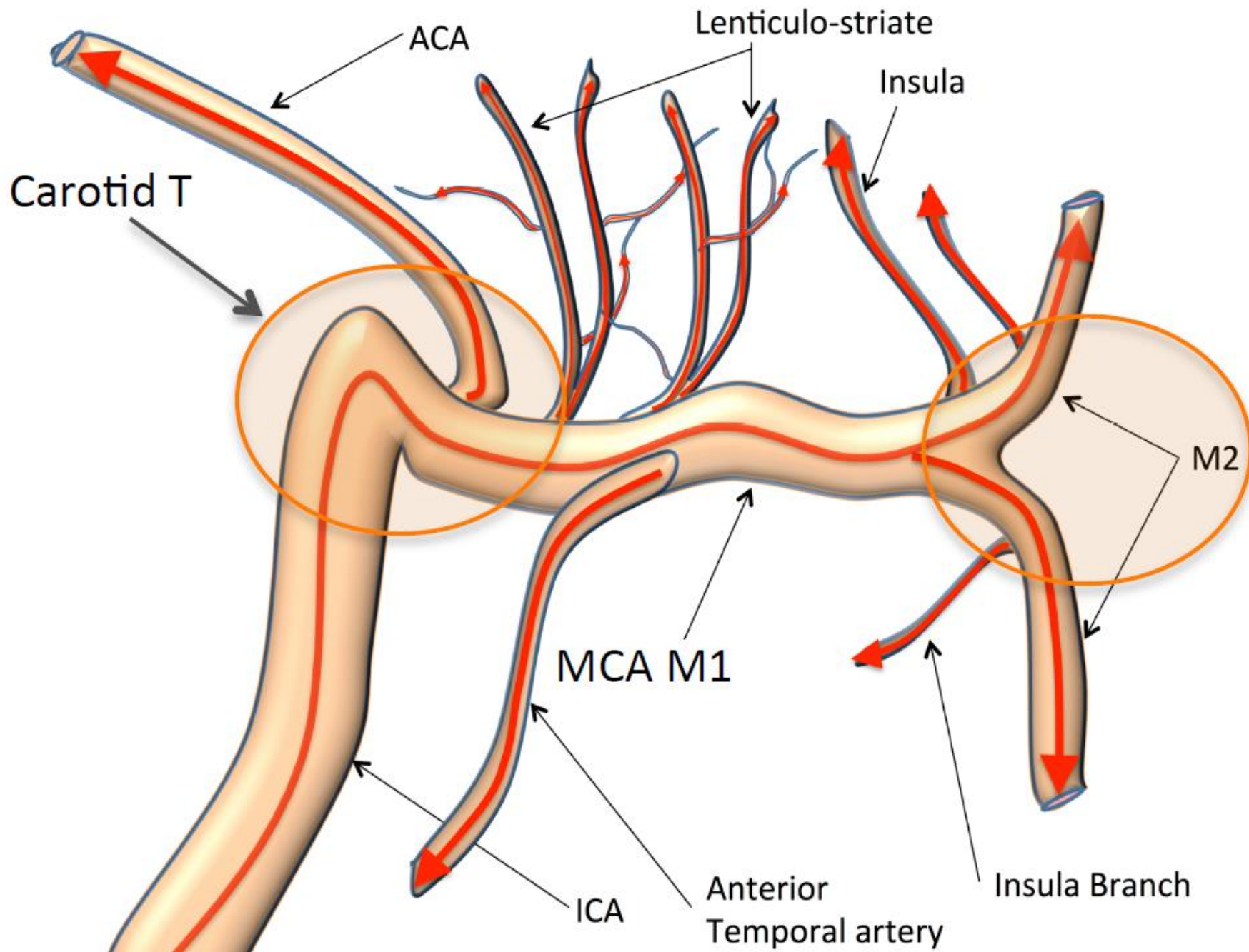
	DIRECT-MT	SKIP	DEVT	MR CLEAN-NO IV	SWIFT DIRECT	DIRECT SAFE
Vessels	ICA, MCA-M1, or M2	ICA or MCA-M1	ICA or MCA-M1	ICA or MCA-M1 or pro-M2	ICA or MCA-M1	ICA or MCA-M1 or BA
NIHSS	≥ 2	≥6	no limit	≥ 2	5-29	no limit
EVT/Bridging	327/329	101/103	116/118	273/266	201/207	146/147
tPA, mg/kg	0.9	0.6	0.9	0.9	0.9	0.9 or TNK
Design	NI	NI	NI	Superiority	NI	NI
NI margin	mRS shift, a margin OR 0.80	mRS 0-2, a margin OR 0.74	mRS 0-2, a margin of 10%	mRS shift, a margin OR 0.80	mRS 0-2; a margin of 12%	0-2 or return to baseline, RD margin 10%
Results	NI shown	NI NOT show	NI shown	NI NOT show	NI NOT show	NI NOT show
Area	China	Japan	China	Europe	Europe and North America	Asia-Pacific area

EVT principles

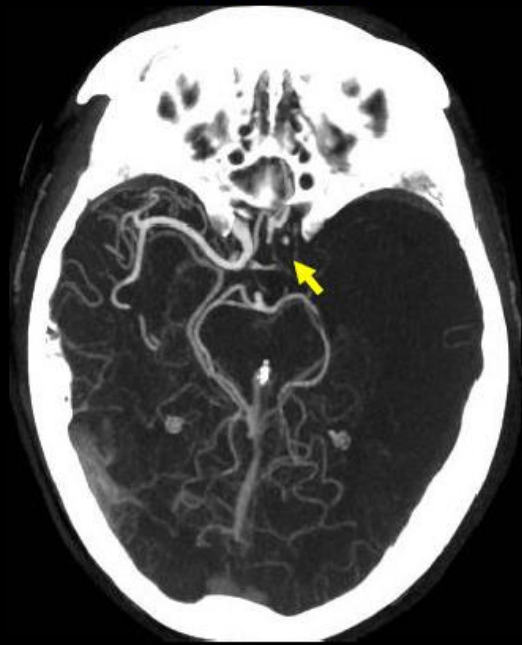
1. IV t-PA first
2. Large intracranial artery occlusion
3. Severe stroke severity
4. Within treatment time window
5. With large salvaged tissue
6. Exclude large infarct core
7. Baseline condition matter

確定大血管阻塞

1. CT angiography:
 - prefer multiphase CTA
2. MR angiography



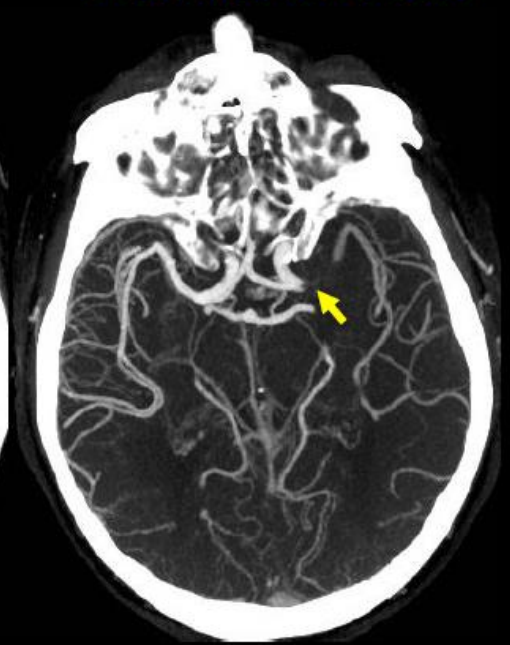
Carotid T



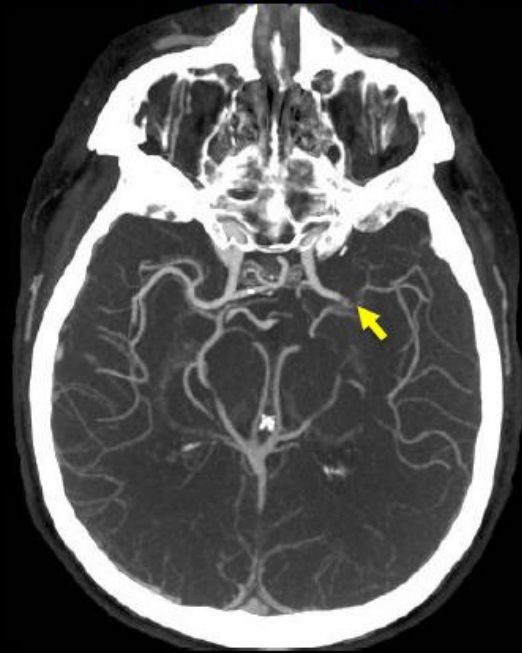
Carotid L



Proximal M1 MCA



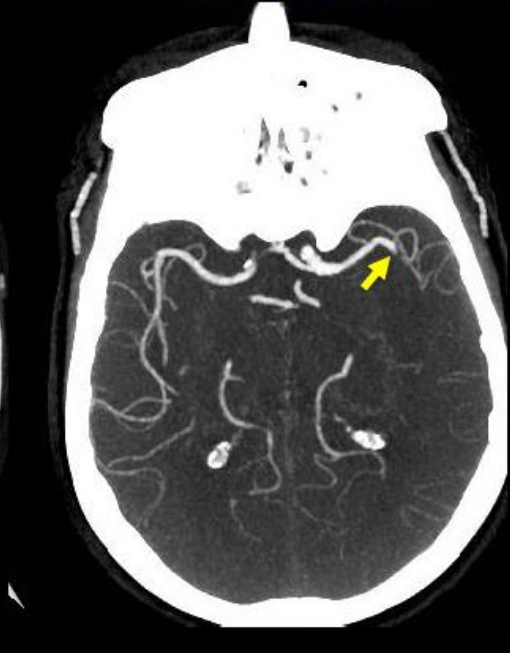
Mid M1 MCA



Distal M1 MCA



All M2 MCA

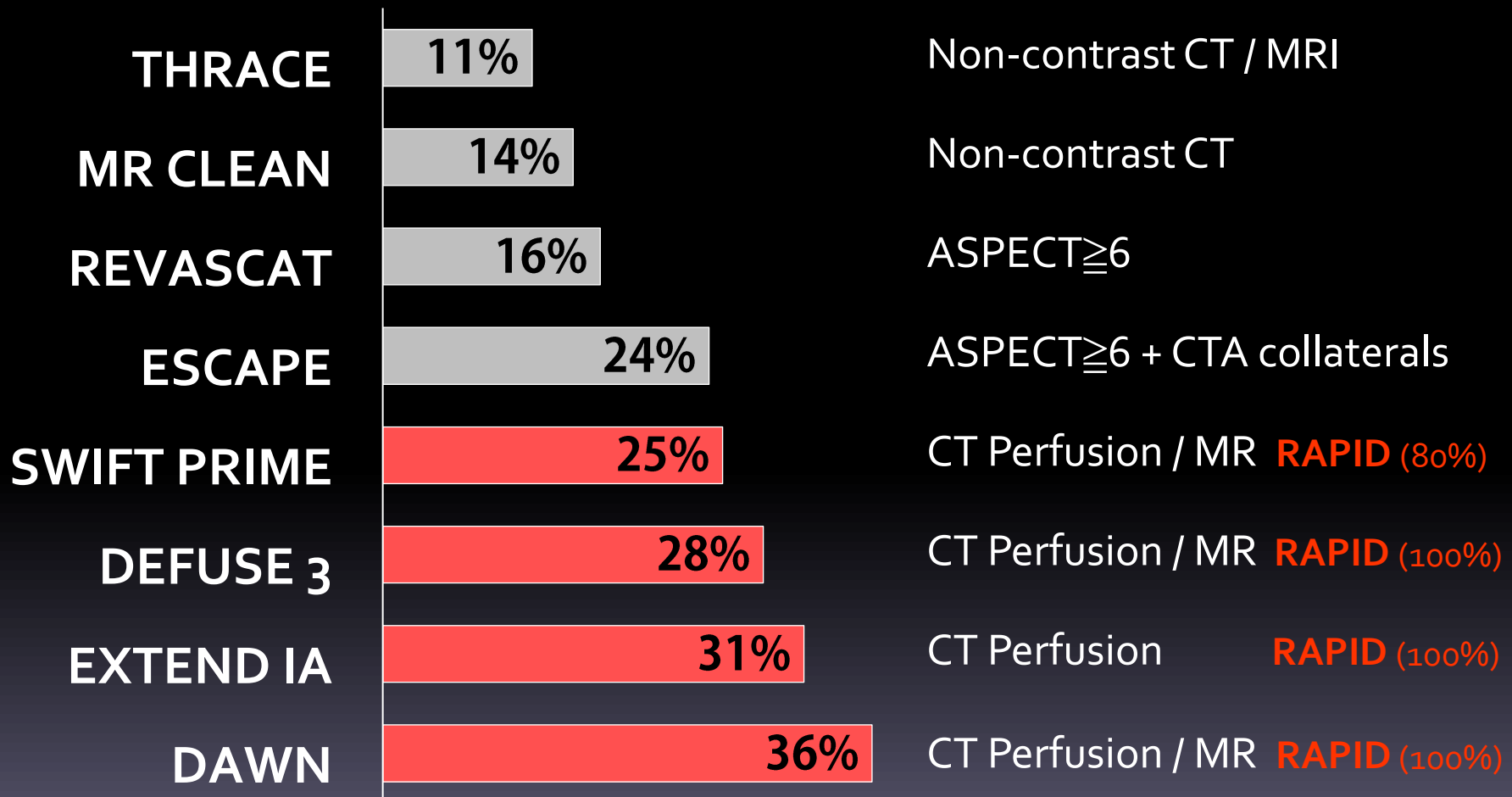


排除 Large Infarct Core

1. ASPECTS in Non-Contrast CT
2. MRI (ADC < 620)
3. CT Perfusion or MR Perfusion
 - rCBF < 30%
 - T-max delay > 6s

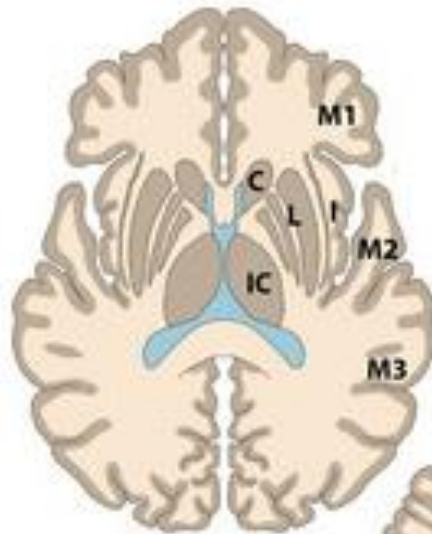
Imaging selection for thrombectomy trials

Absolute benefit: % increase in mRS 0-2 at 90 d

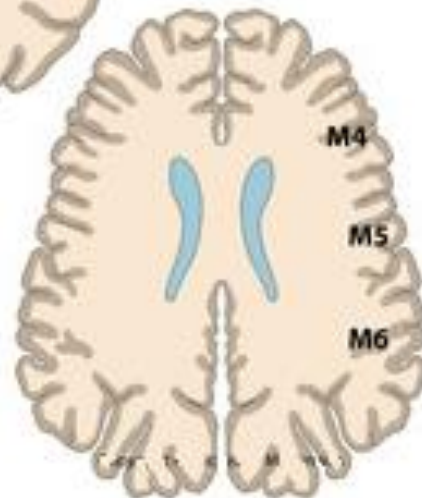


Alberta Stroke Program Early CT Score

Ganglionic Level



Supraganglionic Level



ASPECTS

- C- Caudate
- I- Insular ribbon
- IC- Internal Capsule
- L- Lentiform nucleus
- 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

ASPECTS Score = /10

8-10 small core

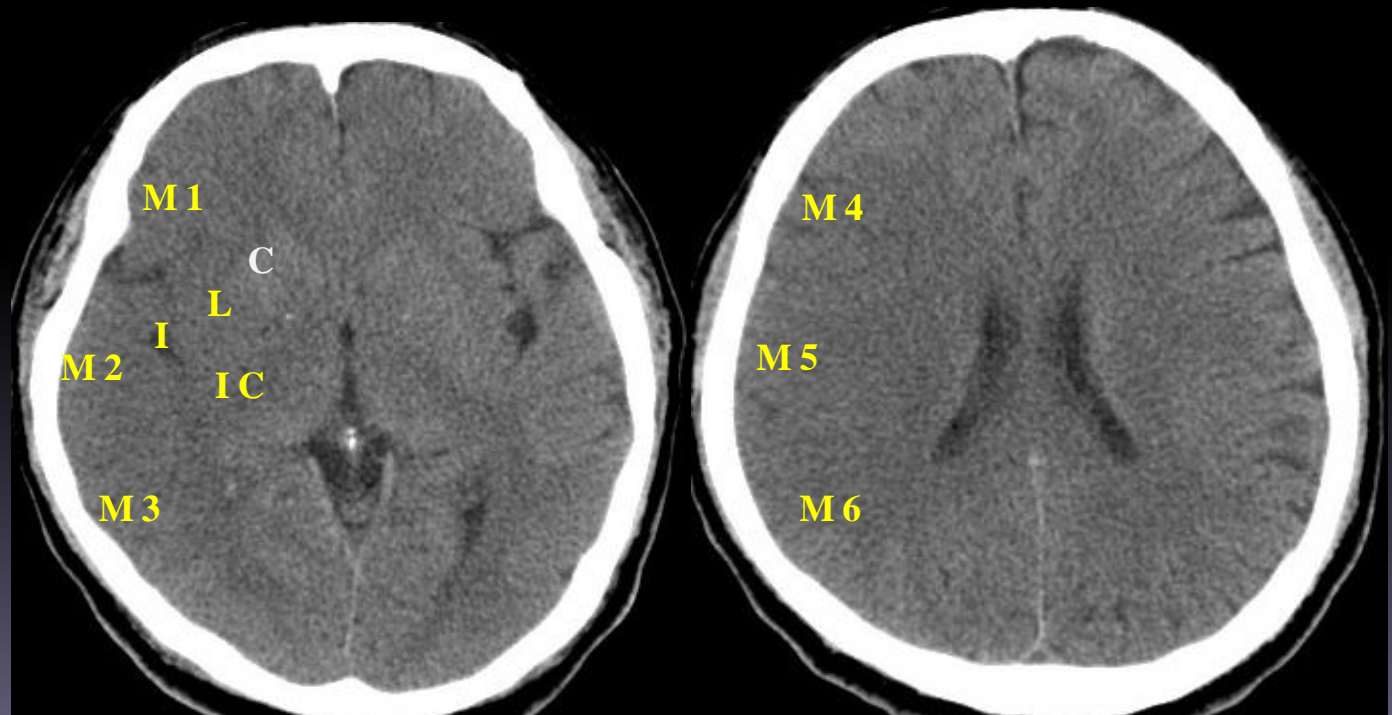
6-7 moderate core

0-5 large core

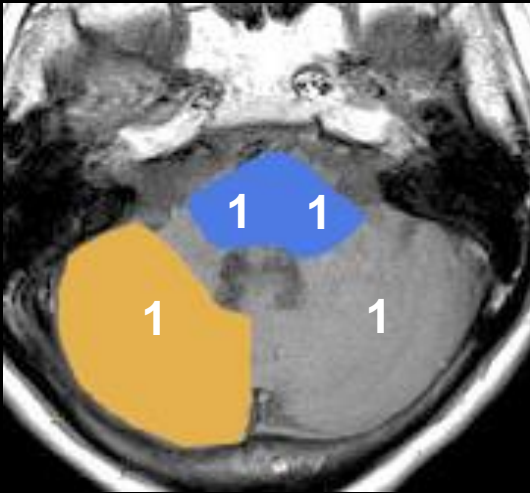
Early ischemic changes in NCCT

- Sulcal effacement
- Loss of insular ribbon
- Loss of gray-white interface
- Basal ganglia hypodensity

ASPECT score = 1

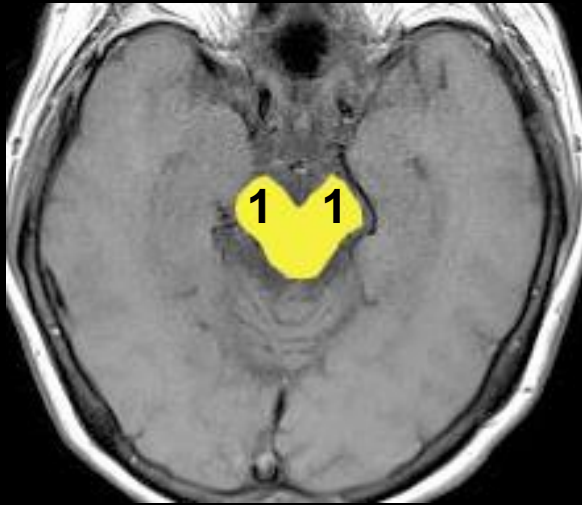


PC ASPECT

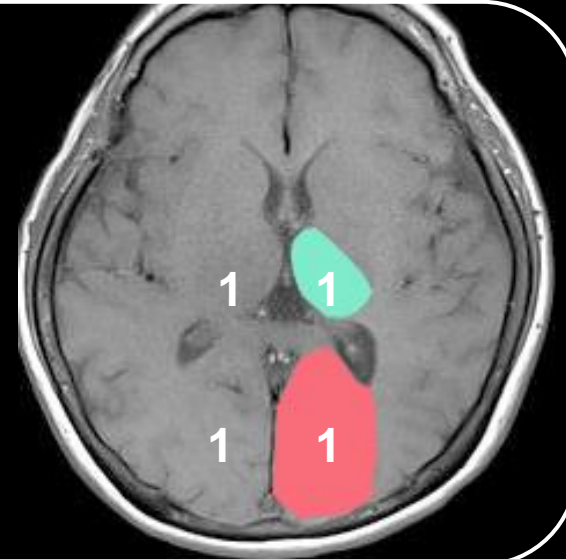


Pons

Cerebellum



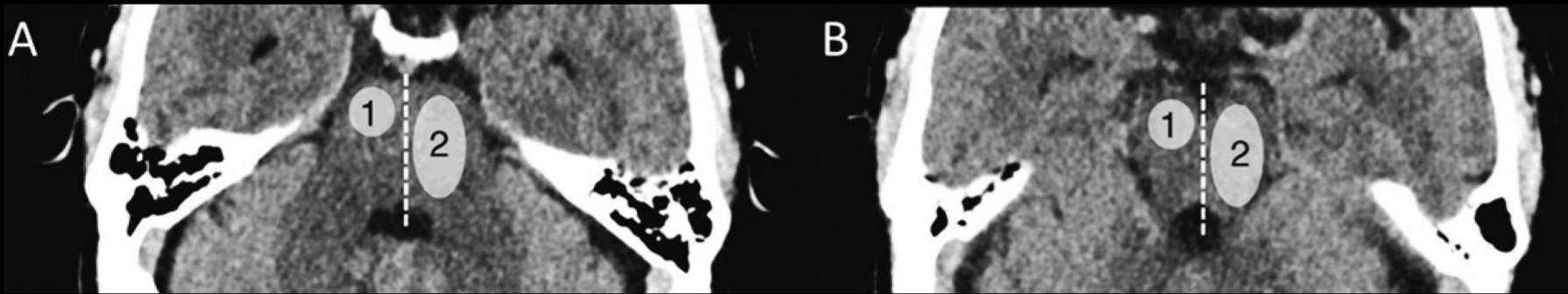
Midbrain



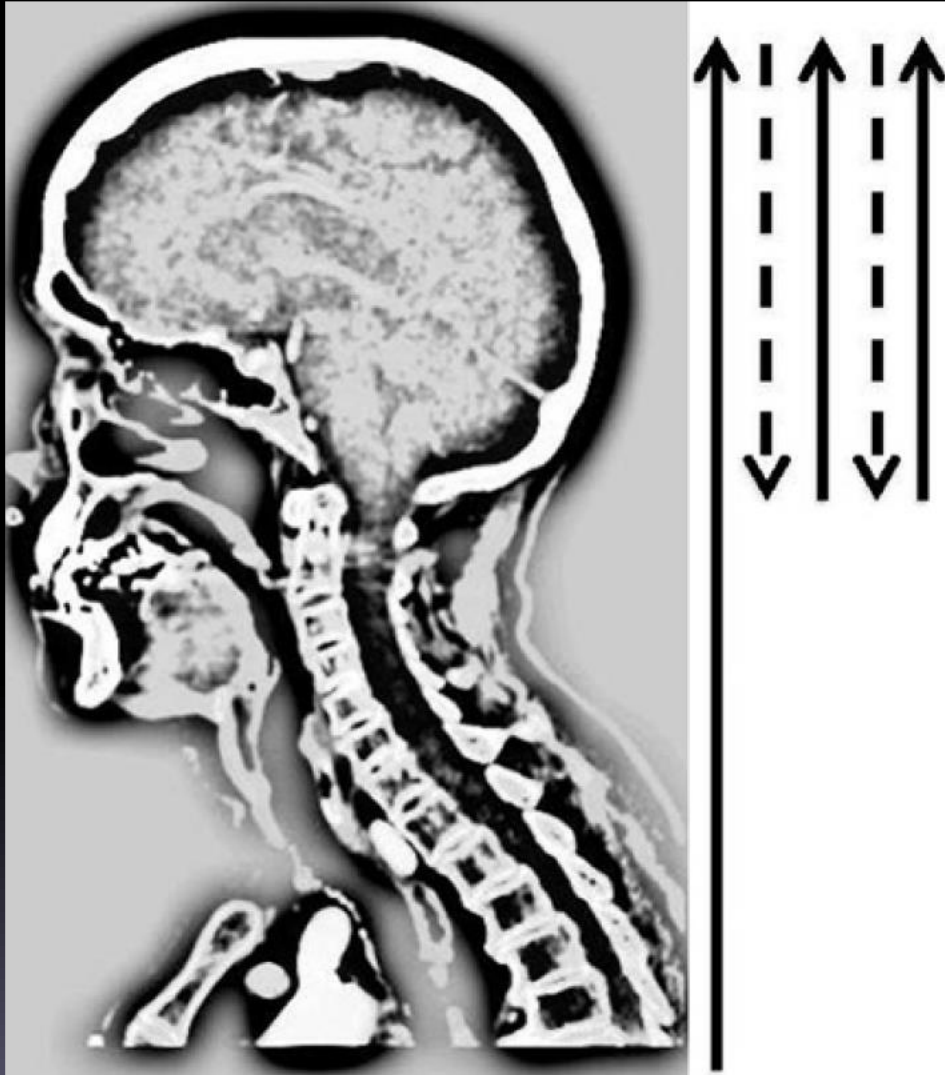
Thalamus

Occipital

Pons-midbrain-Index: 0 - 8



Multiphase CTA



Phase **1**: peak-arterial

Phase **2**: peak-venous

Phase **3**: late-venous

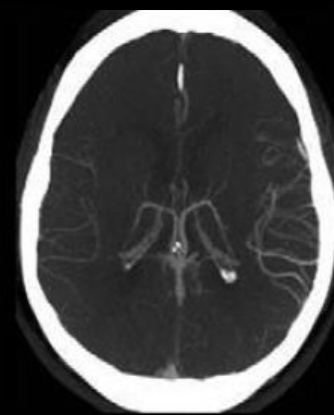
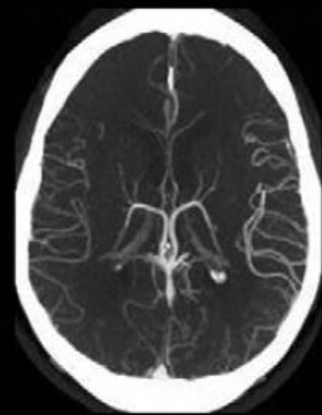
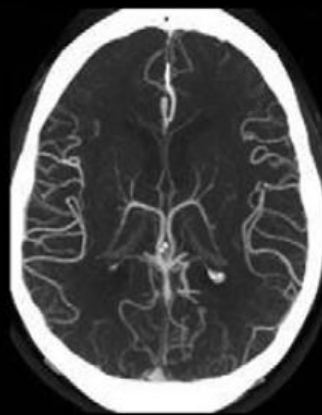
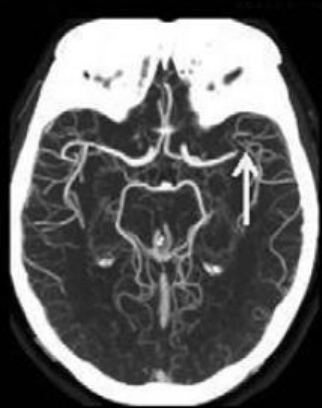
Occlusion Site

Phase 1

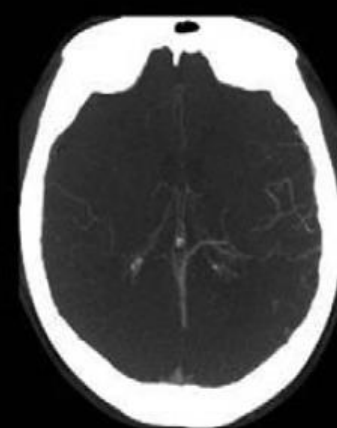
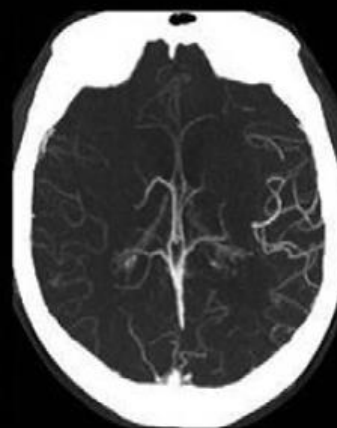
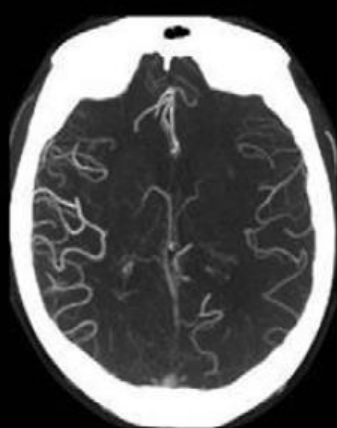
Phase 2

Phase 3

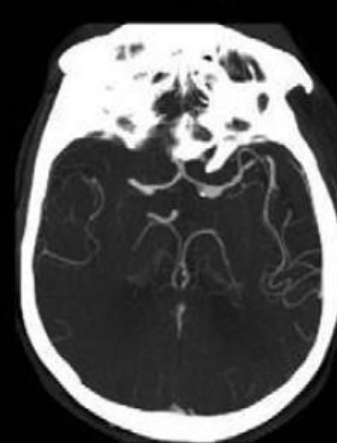
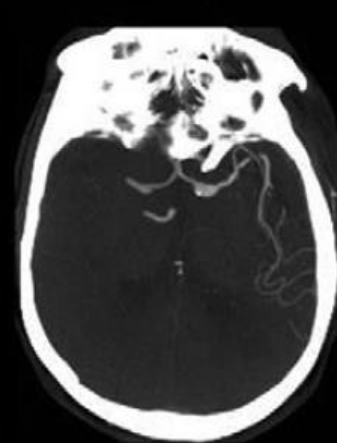
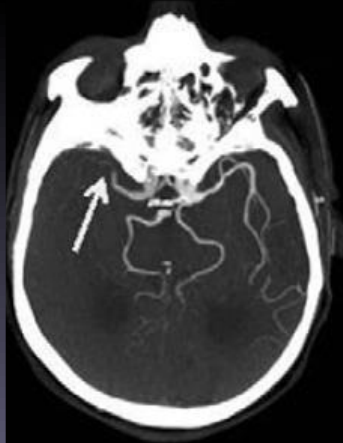
Good



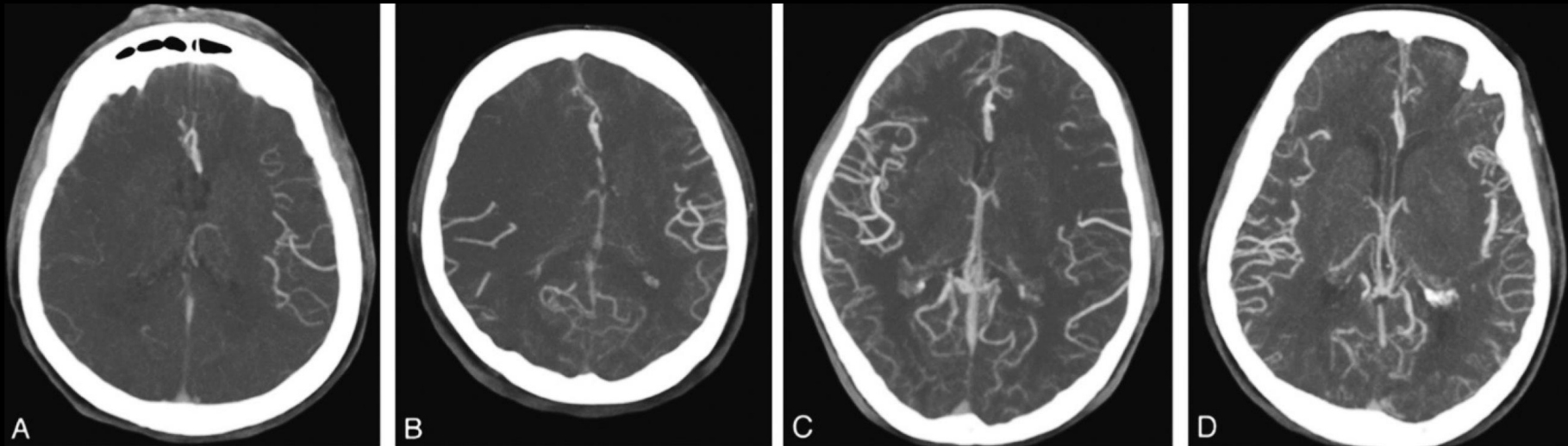
Intermediate



Poor



CTA collateral score, Tan score



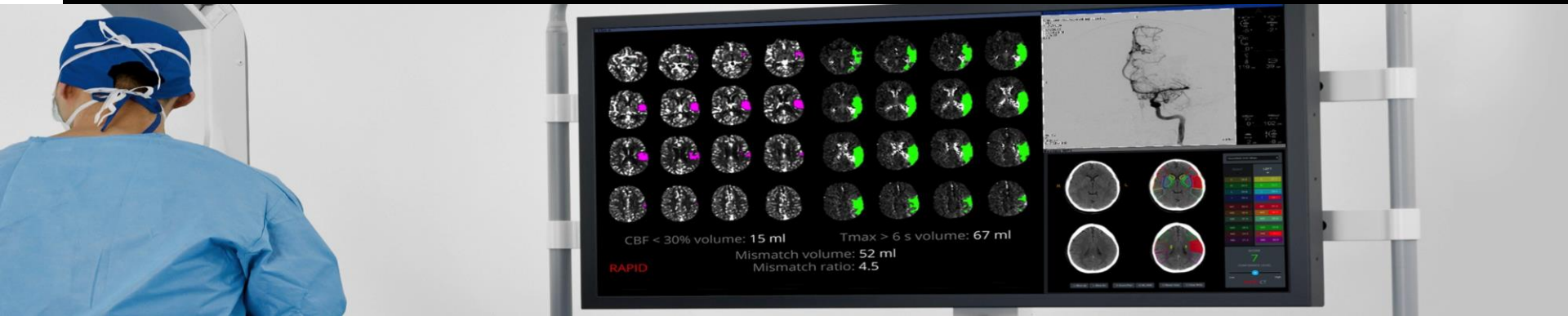
A, score 0: 0% (**no collateral**)

B, score 1: 0%-50% (**poor**)

C, score 2: 51%-99% (**moderate**)

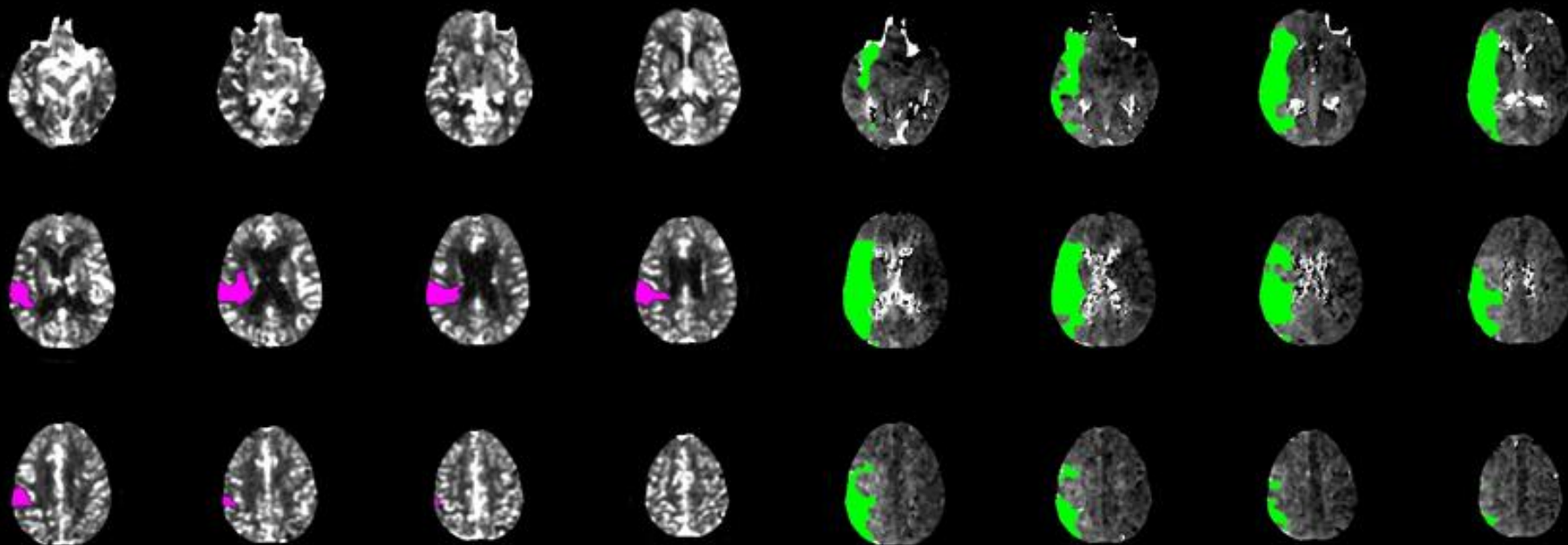
D, score 3: 100% (**good**).

RAPID



- RAPID processing (30 sec – 2 min)
- Fully automated, zero-click workflow
- Quantified outputs
- Intuitive maps, emailed instantly to the team
- CT/MRI, manufacturer independent
- Proven accuracy in numerous clinical trials

RAPID CTP



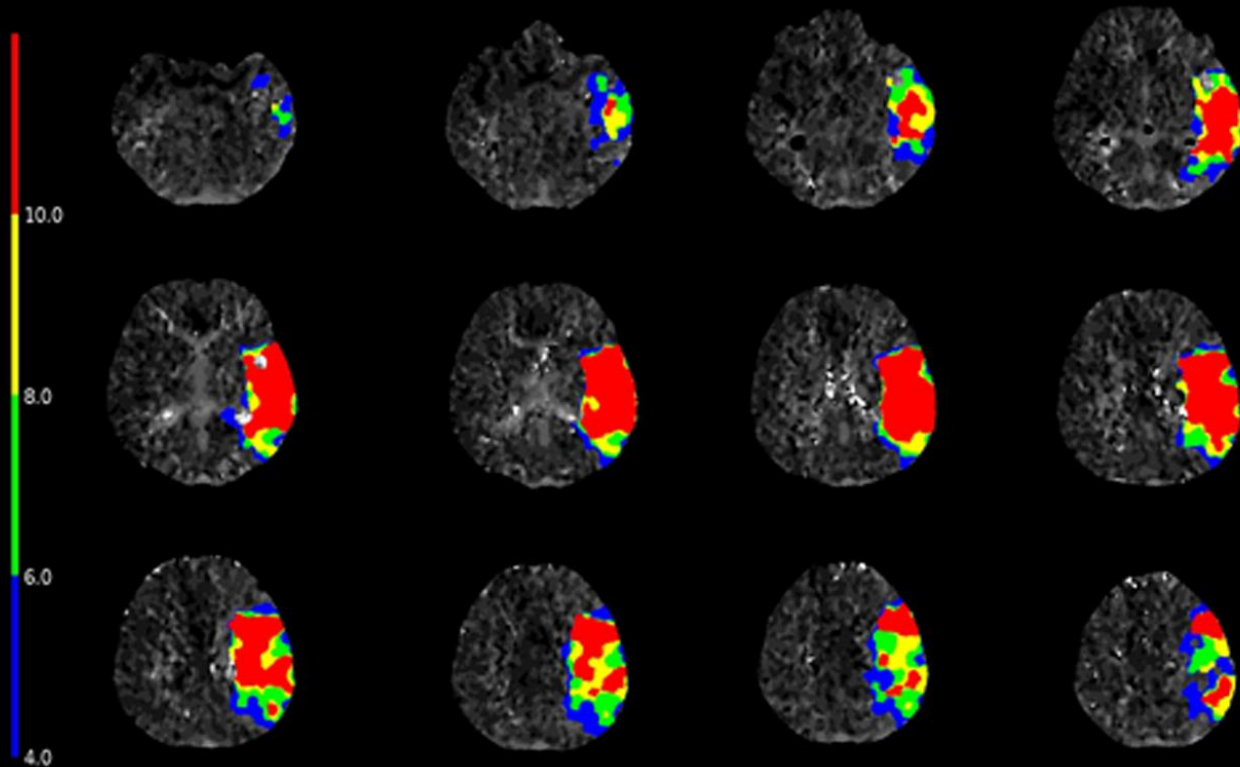
CBF (<30%) volume: 14.9 ml

Perfusion (Tmax>6.0s) volume: 105.4 ml

Mismatch volume: 90.5 ml

Mismatch ratio: 7.1

RAPID Collateral Maps



T_{max}>10s volume: 67 ml

T_{max}>8s volume: 88 ml

T_{max}>6s volume: 112 ml

T_{max}>4s volume: 142 ml

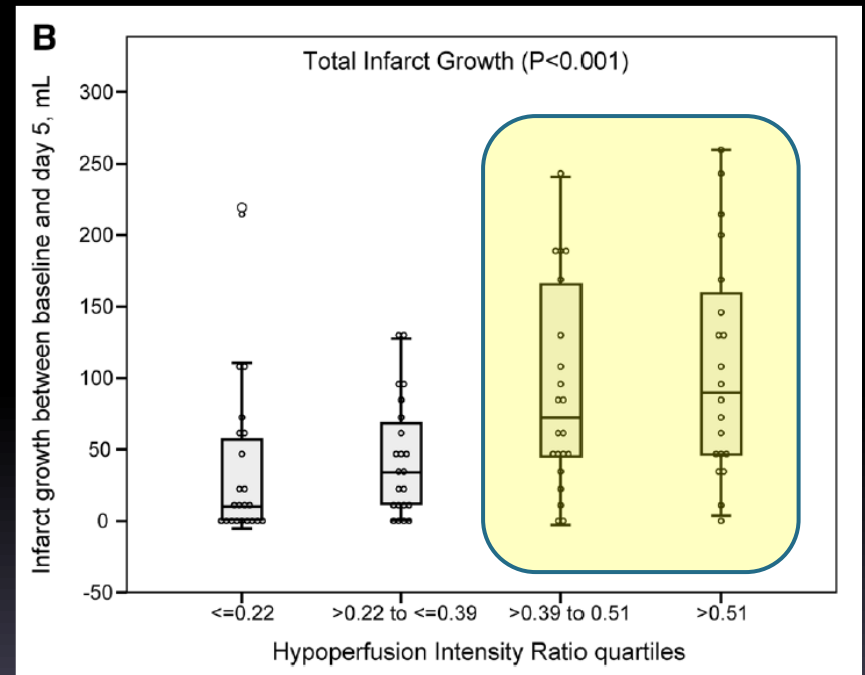
Hypoperfusion Index (T_{max}>10s/T_{max}>6s): 0.6

Hypoperfusion Intensity Ratio (HIR)

- DEFUSE 2 Cohort

~ *Stroke*. 2014;45:1018-1023.

$(T_{\max} > 10s) / (T_{\max} > 6s)$ ratio: **> 0.4**



→ **HIR > 0.4** predicts infarct progression.

Imaging Criteria - **DAWN** < 24 hours

Clinical Imaging Mismatch

Measured by MR-DWI or CTP-rCBF maps:

Age	NIHSS	Infarct Volume
≥ 80	≥ 10	<21 ml
< 80	≥ 10	<31 ml
< 80	≥ 20	<51 ml

Imaging Criteria – DEFUSE 3 < 16 hours

Target Mismatch Profile

Measured by MR or CT Perfusion maps:

Core volume	$T_{\max} > 6s$ / Core Ratio	Mismatch Volume
<70 ml	>1.8	>15 ml

rCBF<30% or DWI



Thank you for listening.