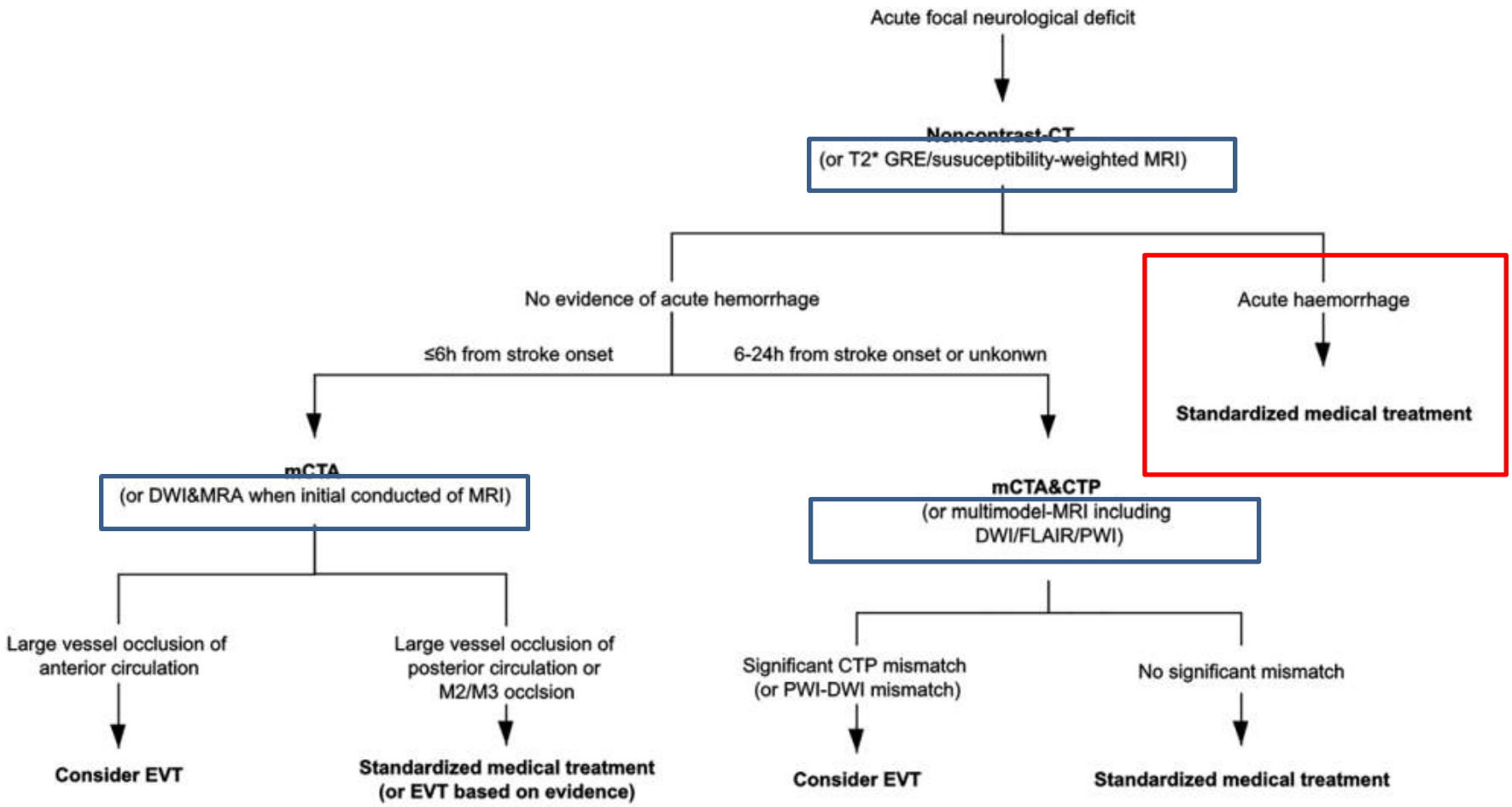
IV. Girişimsel Nöroloji Eğitim Toplantısı

Patofizyoloji ve Nörogörüntüleme

Akut İnmede MRI

21-22 Mayıs 2022, Gaziantep

Anıl Tanburoğlu
Beyin Damar Hastalıkları ve İnme Merkezi
BAŞKENT ÜNİVERSİTESİ


Acute focal neurological deficit
Noncontrast-CT
(or T2* GRE/susuceptibility-weighted MRI)
No evidence of acute hemorrhage
Acute haemorrhage
Standardized medical treatment
≤6h from stroke onset
6-24h from stroke onset or unkonwn
mCTA
(or DWI&MRA when initial conducted of MRI)
mCTA&CTP
(or multimodel-MRI including DWI/FLAIR/PWI)
Large vessel occlusion of anterior circulation
Large vessel occlusion of posterior circulation or M2/M3 occlsion
Significant CTP mismatch (or PWI-DWI mismatch)
No significant mismatch
Consider EVT
Standardized medical treatment (or EVT based on evidence)
Consider EVT
Standardized medical treatment

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Patofizyoloji ve Nörogörüntüleme

Akut İskemik İnmede MRI

21-22 Mayıs 2022, Gaziantep

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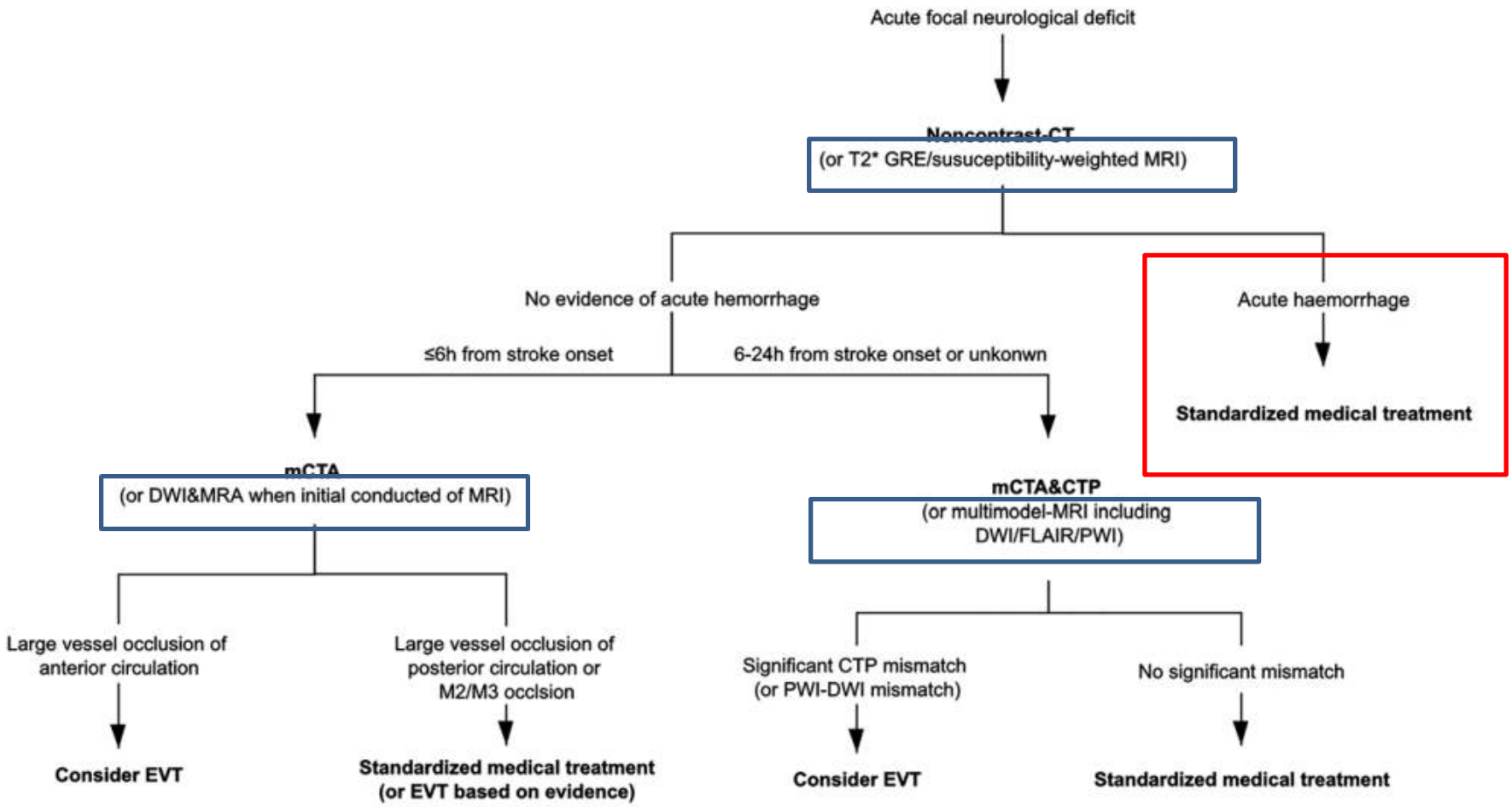
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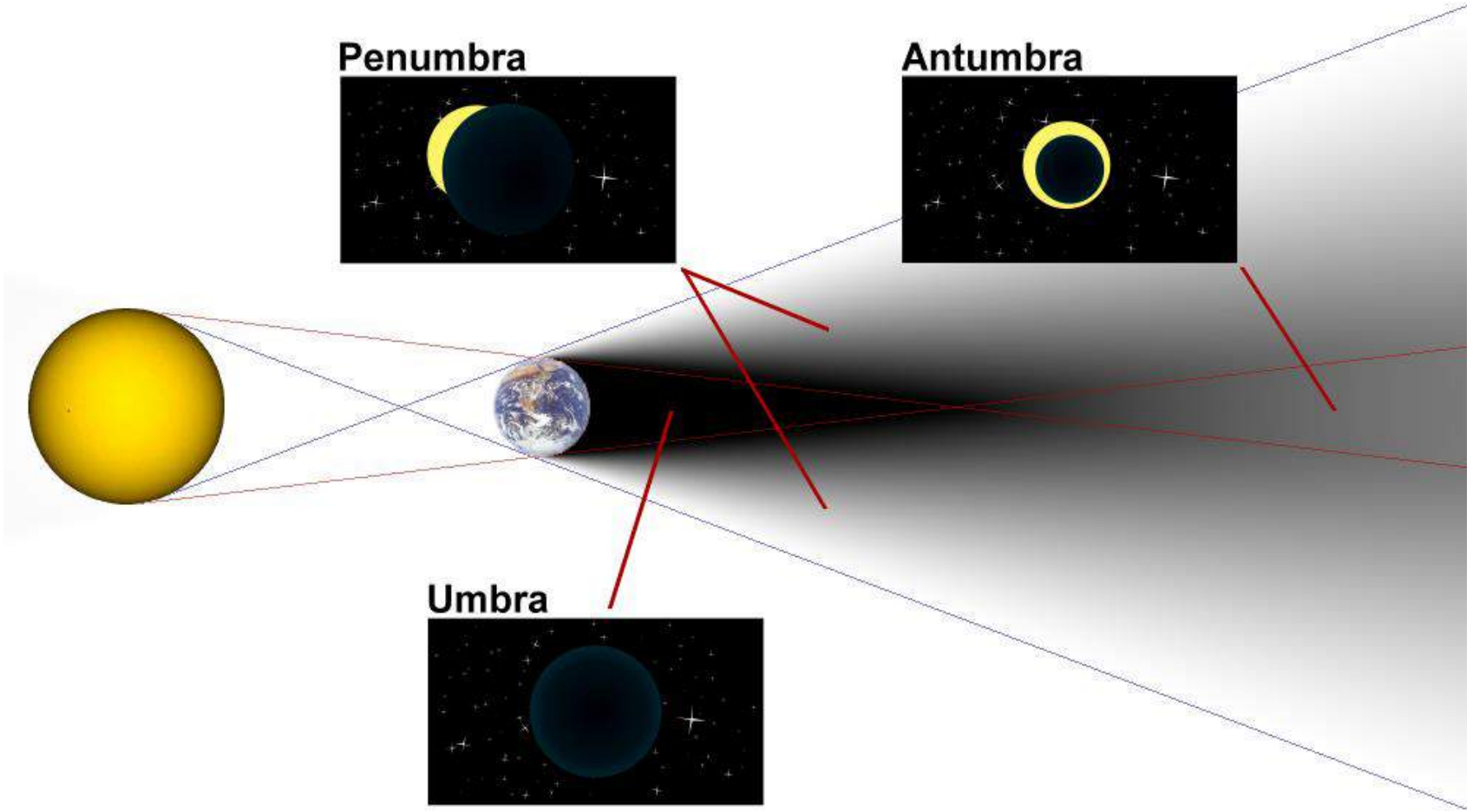
No significant mismatch
Consider EVT
Standardized medical treatment (or EVT based on evidence)
Consider EVT
Standardized medical treatment

Table 1: Advantages and limitations of CT and MR imaging.

Imaging characteristics	CT	MRI
Availability in primary health care institutions	++	–
Lower cost	+	–
Rapid image acquisition	++	+
Lack of vulnerability to motion artifacts	+	–
Lower signal-to-noise ratio	++	+
Less ionizing radiation	–	++
Feasibility and safety for patients with metallic implants	++	–
Less time for postprocessing of multimodal imaging	–	–
Renal toxicity associated with contrast administration	+	+
Ability to assess causes of ICH while in the scanner	+	+
Detection of intracranial hemorrhage including microbleeds	+	++

Patofizyoloji

- Kor-penumbra modeli?
  - Tüm modeller yanlıştır ama bazıları yararlıdır
  - KOR:
  - PENUMBRA: elektriksel aktivite kaybı,potansiyel düzelme
  - akım eşikleri yaklaşıktır, kor ise ana oyuncudur
- Zamanın sayısallığı ve mekansallığı(doku penceresi)
- Bireysel farklar(precision medicine)



The **penumbra** is the part of a shadow where the light source is only partially blocked.

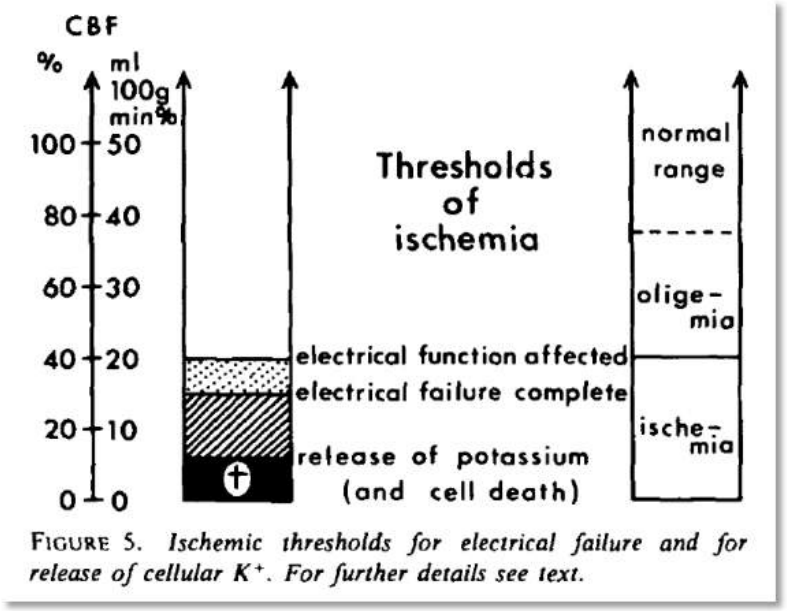
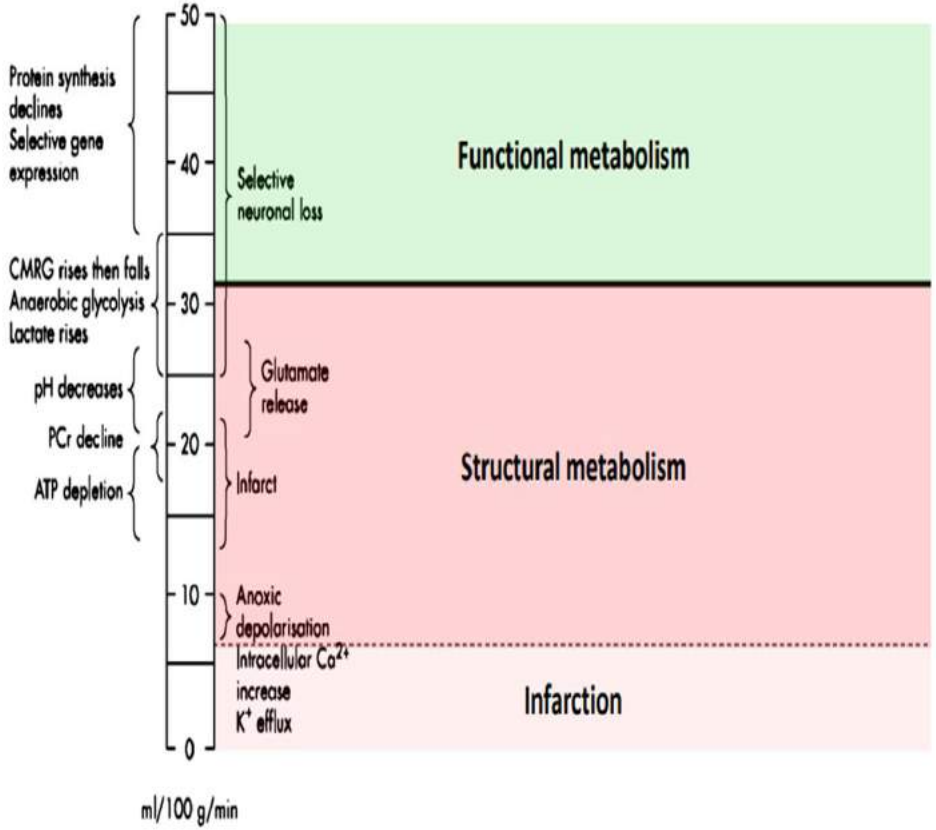


FIGURE 5. *Ischemic thresholds for electrical failure and for release of cellular K^+. For further details see text.*

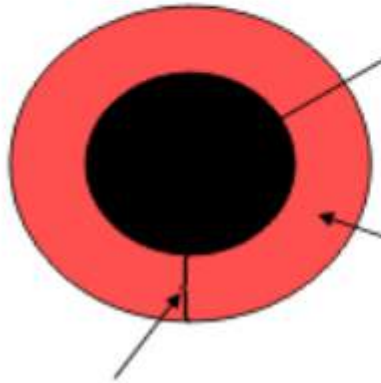


Astrup J, Symon L, Branston NM, Lassen NA. Stroke. 1977 Jan-Feb;8(1):51-7.

- Ortalama beyin akımı; 56 ml/dk'nın üzeri
- 30-50 ml/dk .....oligemi
  - geçici iskemi
- 20-30 ml/dk.....iskemi
  - serebral disfonksiyon
- 10-15 ml/dk altı.....hücre ölümü
- Kan akımı tamamen kesildiği zaman
  - 3 dk içerisinde hücre ölümü

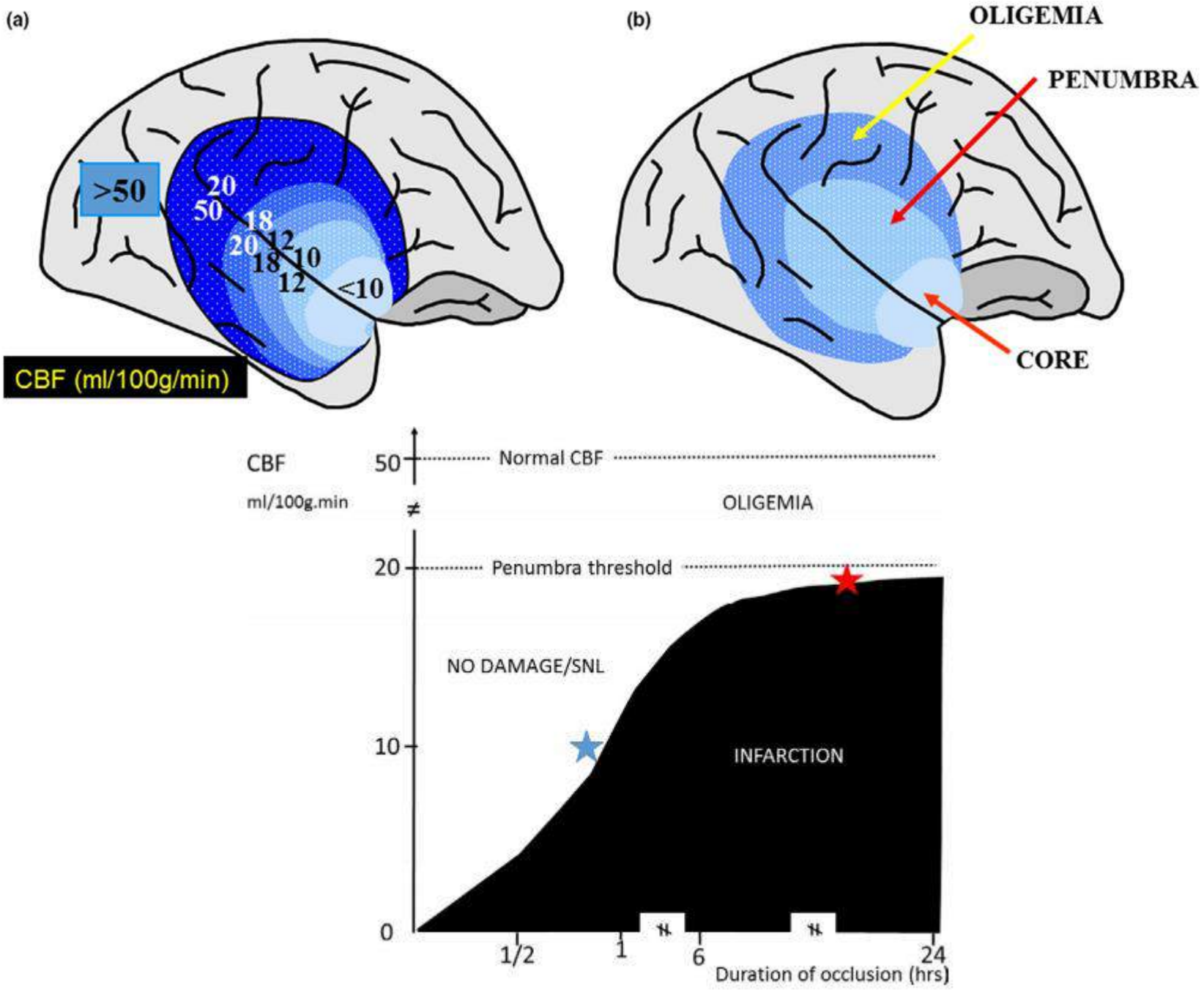
Ischemic Penumbra

DWI / PWI Mismatch

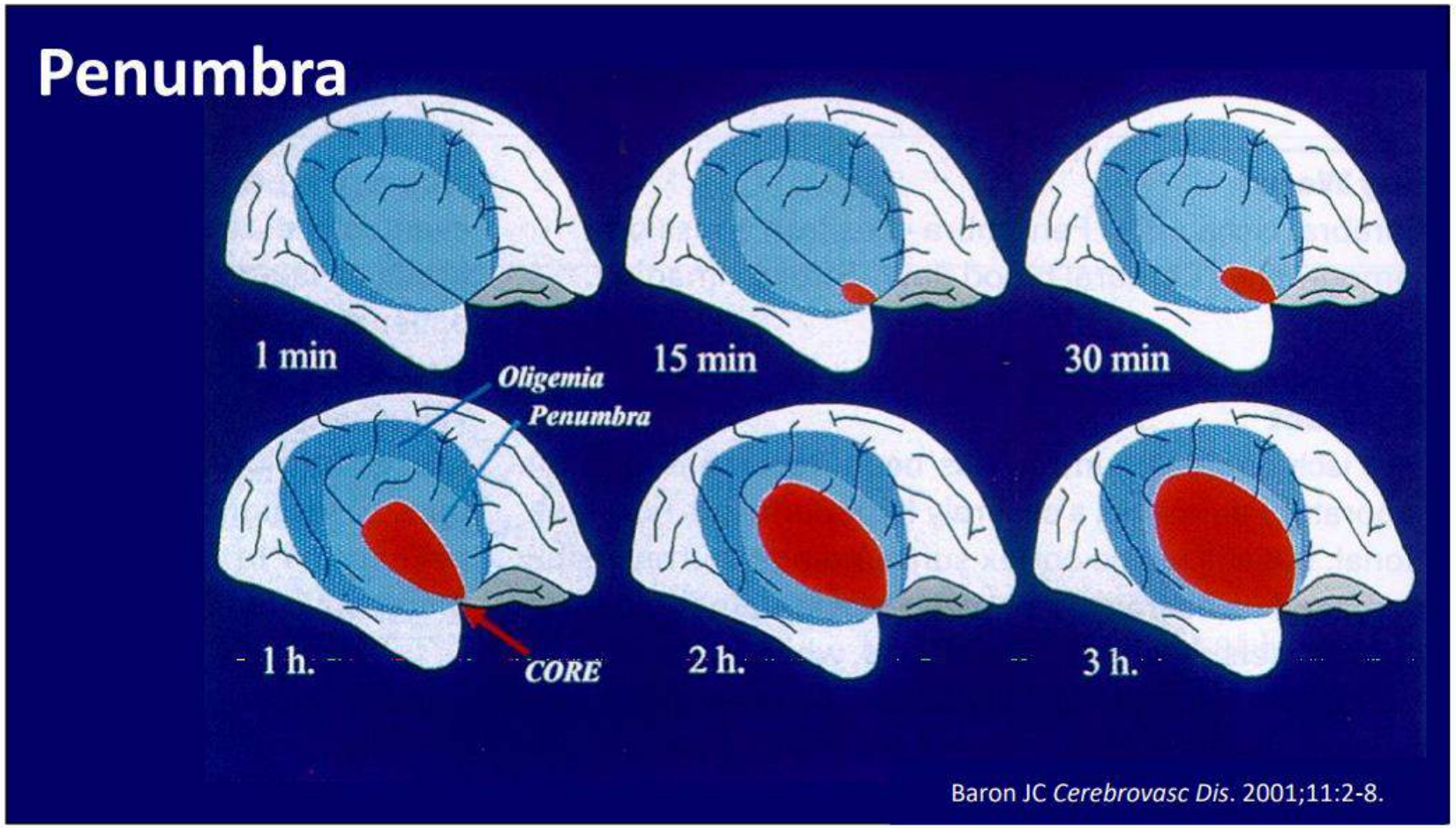


- Diffusion Abnormality
- CBF < 10 ml/100g/min
- Cytotoxic edema
- Irreversible ischemia

- Perfusion Abnormality
- CBF = 10-18 ml/100g/min
- Neuronal paralysis
- Reversible ischemia


(a)
>50
20
50
18
20
12
18
10
12
<10
CBF (ml/100g/min)
(b)
OLIGEMIA
PENUMBRA
CORE
CBF
ml/100g.min
50
Normal CBF
≠
OLIGEMIA
20
Penumbra threshold
NO DAMAGE/SNL
INFARCTION
10
0
1/2
1
6
24
Duration of occlusion (hrs)

KOLLATERAL dokunun yaşayabilmesi için zorunludur!



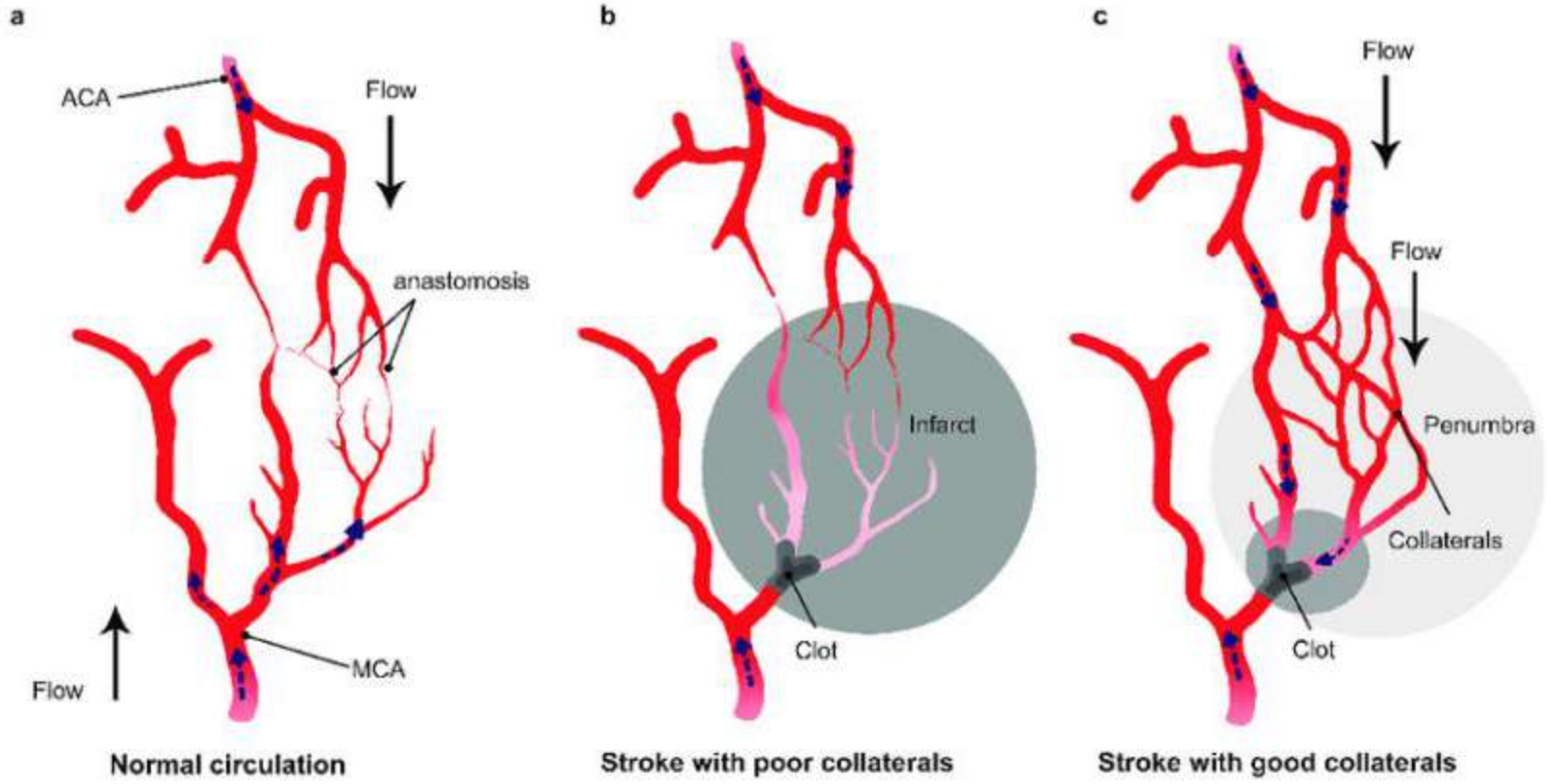
Loss of electrical function with intact cell membranes[1]

„fundamentally reversible“[2]

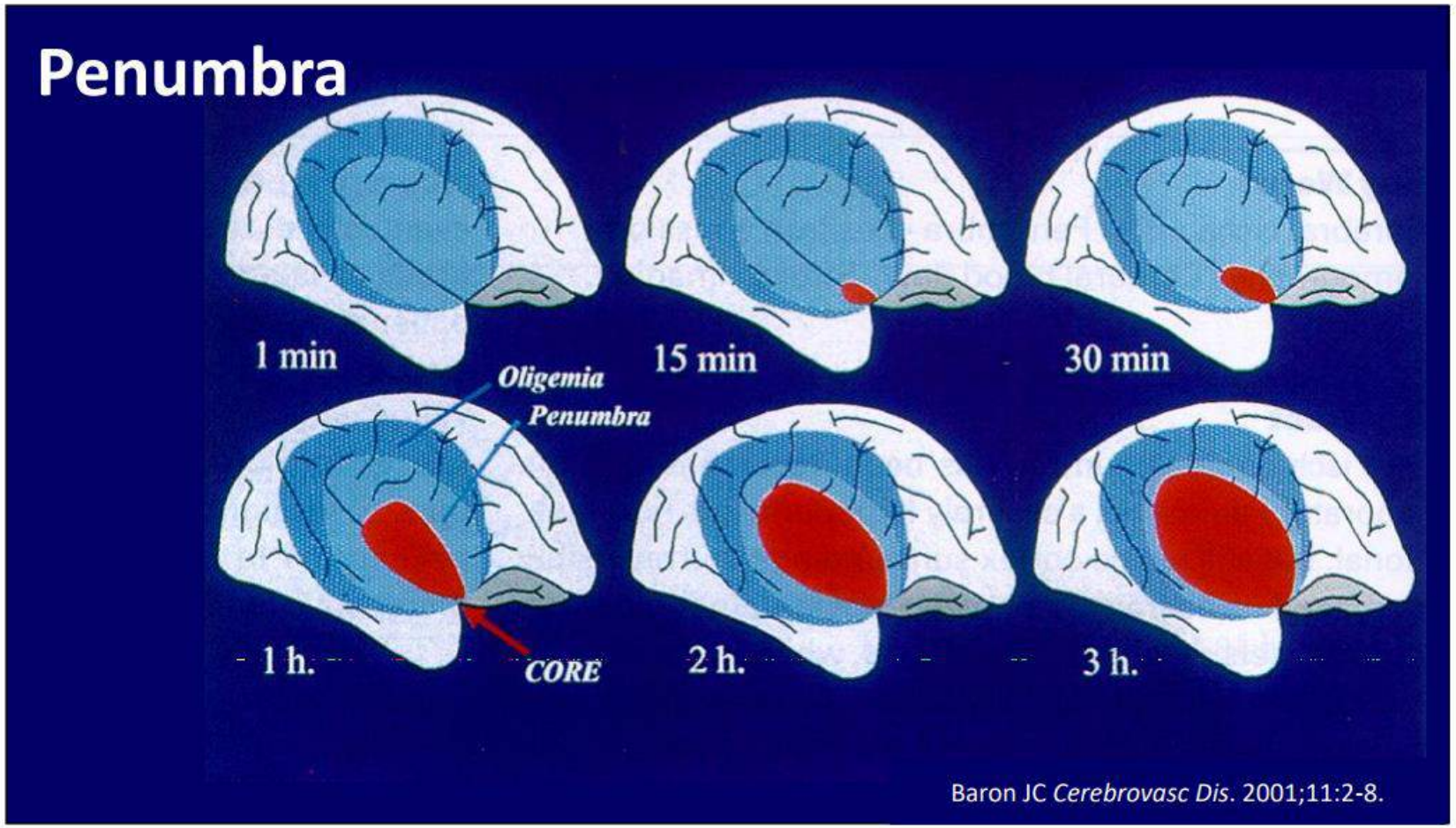
[1] Astrup J et al. *Stroke*. 1981;12:723-725

[2] Hakim AM et al. *JCBFM*. 1989;9:523-534

Collaterals



KOLLATERAL dokunun yaşayabilmesi için zorunludur!



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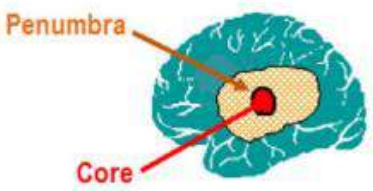
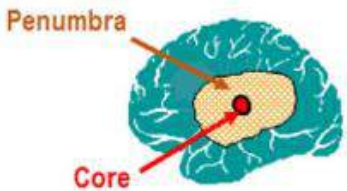
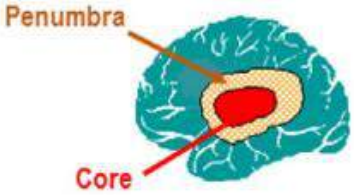
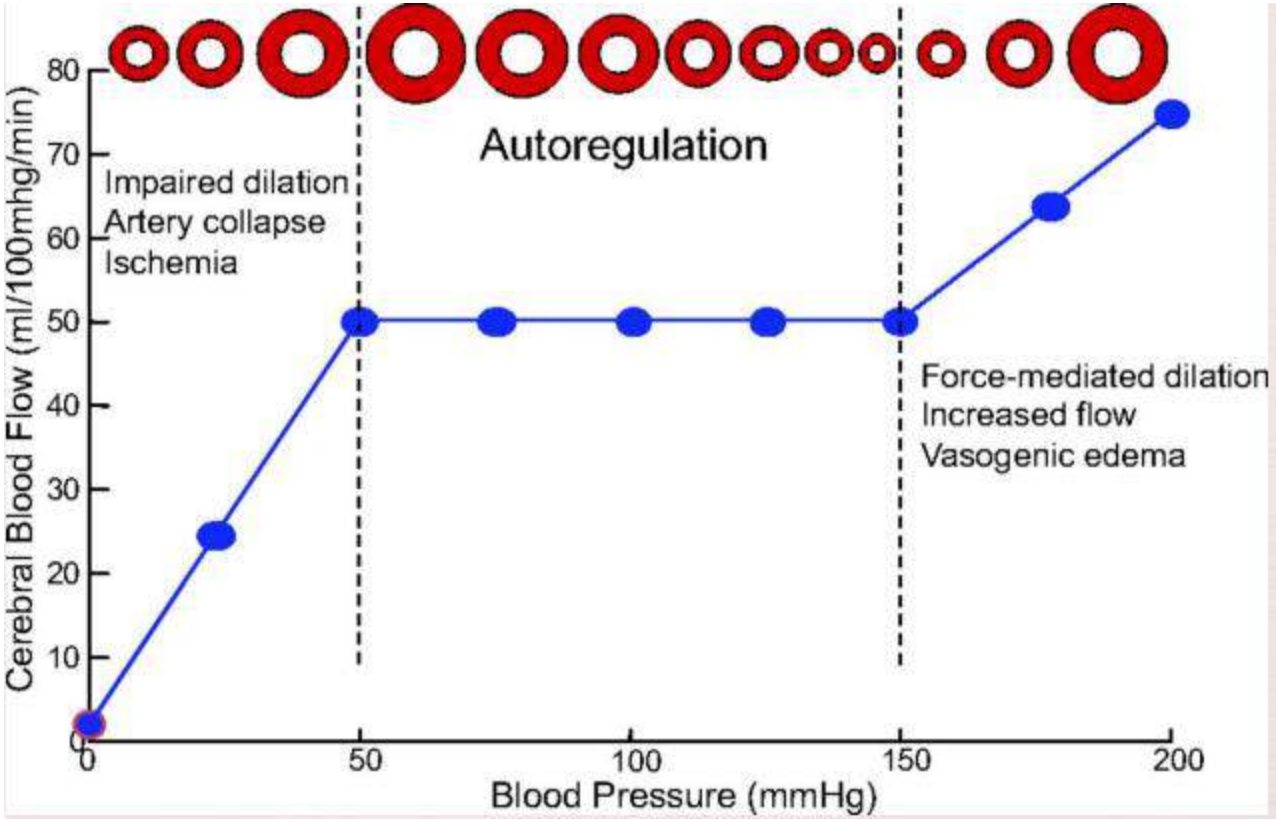
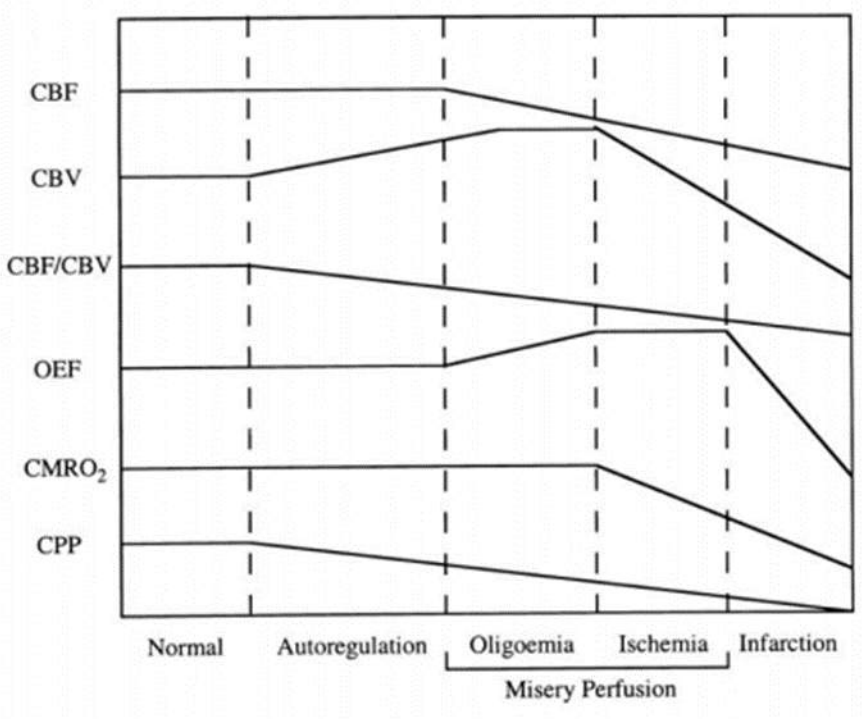
	3hr after stroke onset	At time of recanalization	Successful recanalization: final infarct	Failed recanalization: final infarct
Average collaterals	 NIHSS = 15	 1.5hr later: NIHSS = 15	 mRS=2	 mRS=5
Good collaterals/slow progressor	 NIHSS = 15	 12hr later: NIHSS = 15	 mRS=0	 mRS=5
Poor collaterals/fast progressor	 NIHSS = 15	 1.5hr later: NIHSS = 15	 mRS=4	 mRS=5


Autoregulation
Impaired dilation
Artery collapse
Ischemia
Force-mediated dilation
Increased flow
Vasogenic edema
Cerebral Blood Flow (ml/100mhg/min)
Blood Pressure (mmHg)
0
10
20
30
40
50
60
70
80
0
50
100
150
200



Evre 1 Vasodilatasyon
Evre 2 OEF Artışı

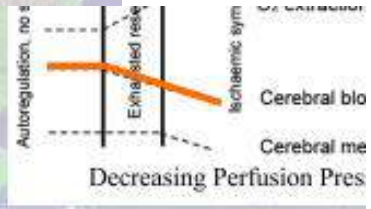
Powers WJ et al. Ann Intern Med 1987;106:27–35.

CBV

- Cerebral Blood Volume
- 'Percentage of blood vessels in a specific volume of tissue'
- Higher in cortex and basal ganglia
- Changes with autoregulation and dilatation or constriction of vessels

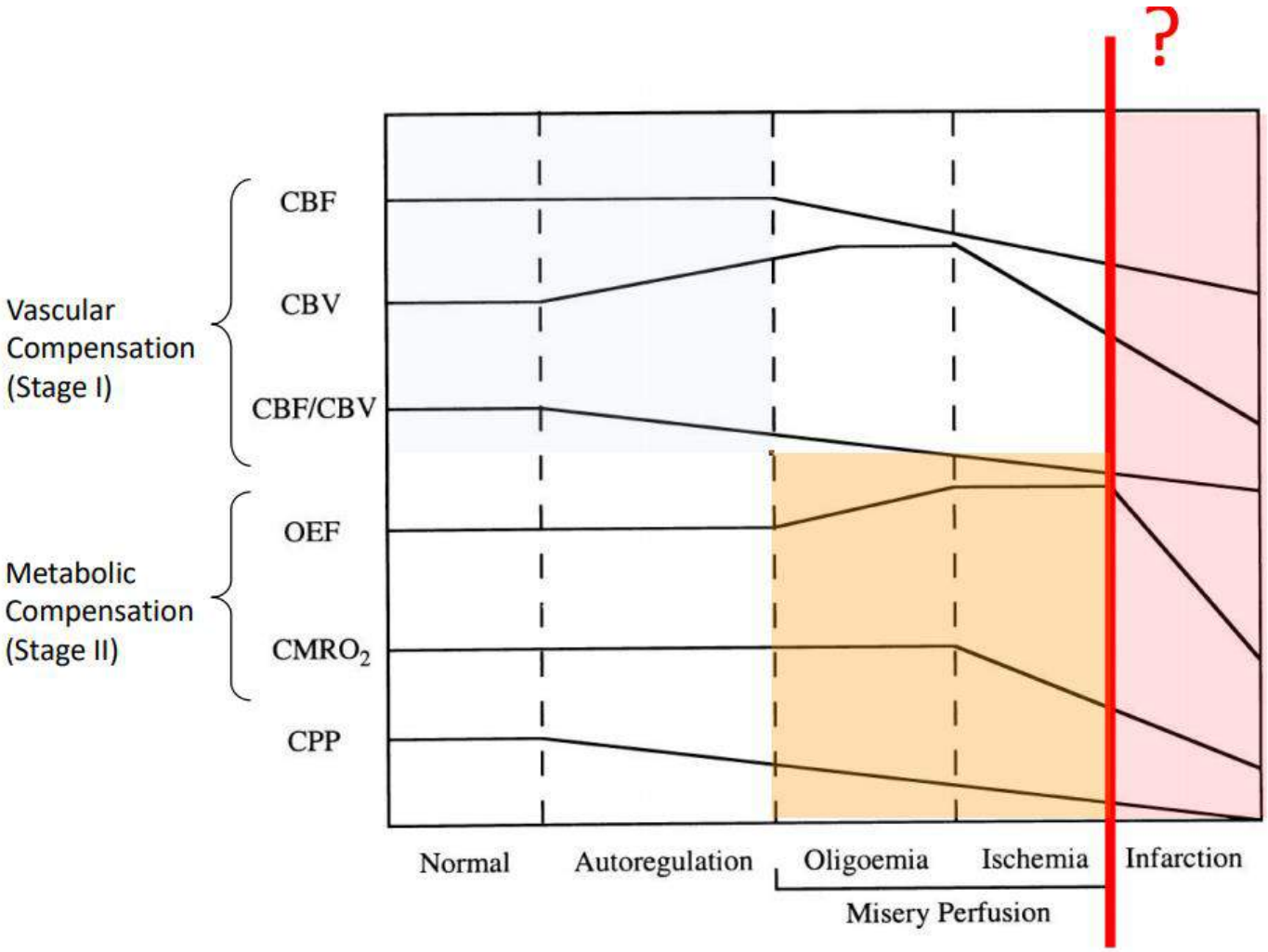
- CBV in core ↓, in penumbra =↑

CBF



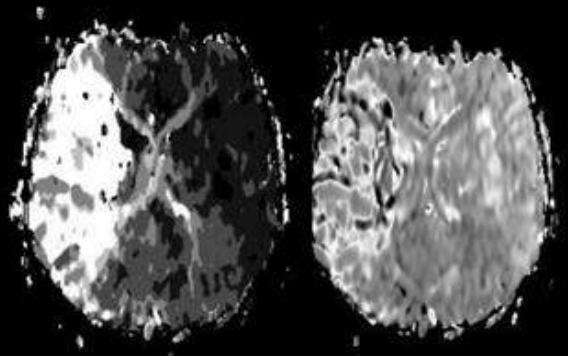
- Cerebral Blood Flow
- Normal: 50-80 ml/100g braintissue/min
- Higher energy demand: cortex, basal ganglia: 2-3x white matter
- autoregulation: diameter change vessels
- In case of max. dilatation and decrease perfusion pressure: CBF ↓

CBF↓	core en penumbra
MTT↑	core, penumbra luxury perfusion
↓CBV	infarct core
=/ ↑ CBV	penumbra



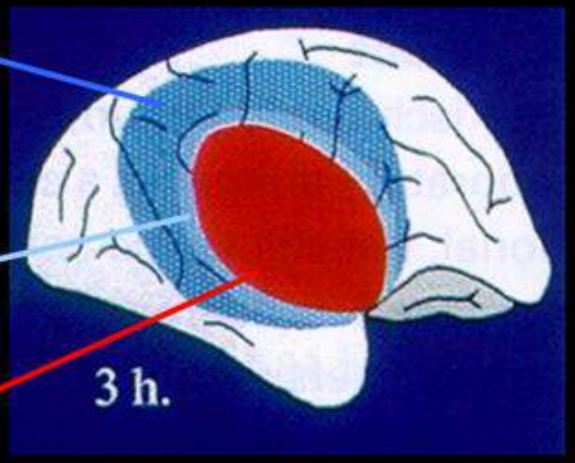
Gibbs J, Wise R, Leenders K, Jones T. Evaluation of cerebral perfusion reserve in patients with carotid-artery occlusion. *Lancet*. 1984:310-314

Pathophysiology: Perfusion parameters



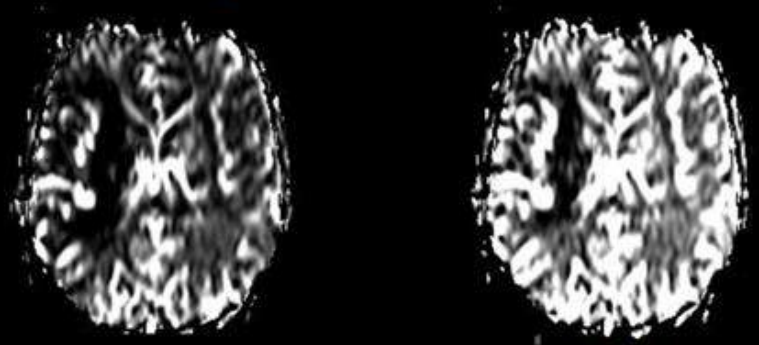
TTP MTT

Oligemia

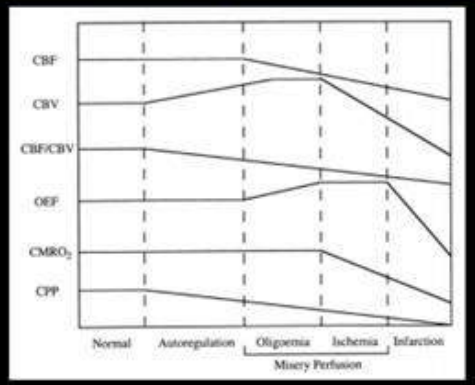


Penumbra

Core



CBF CBV



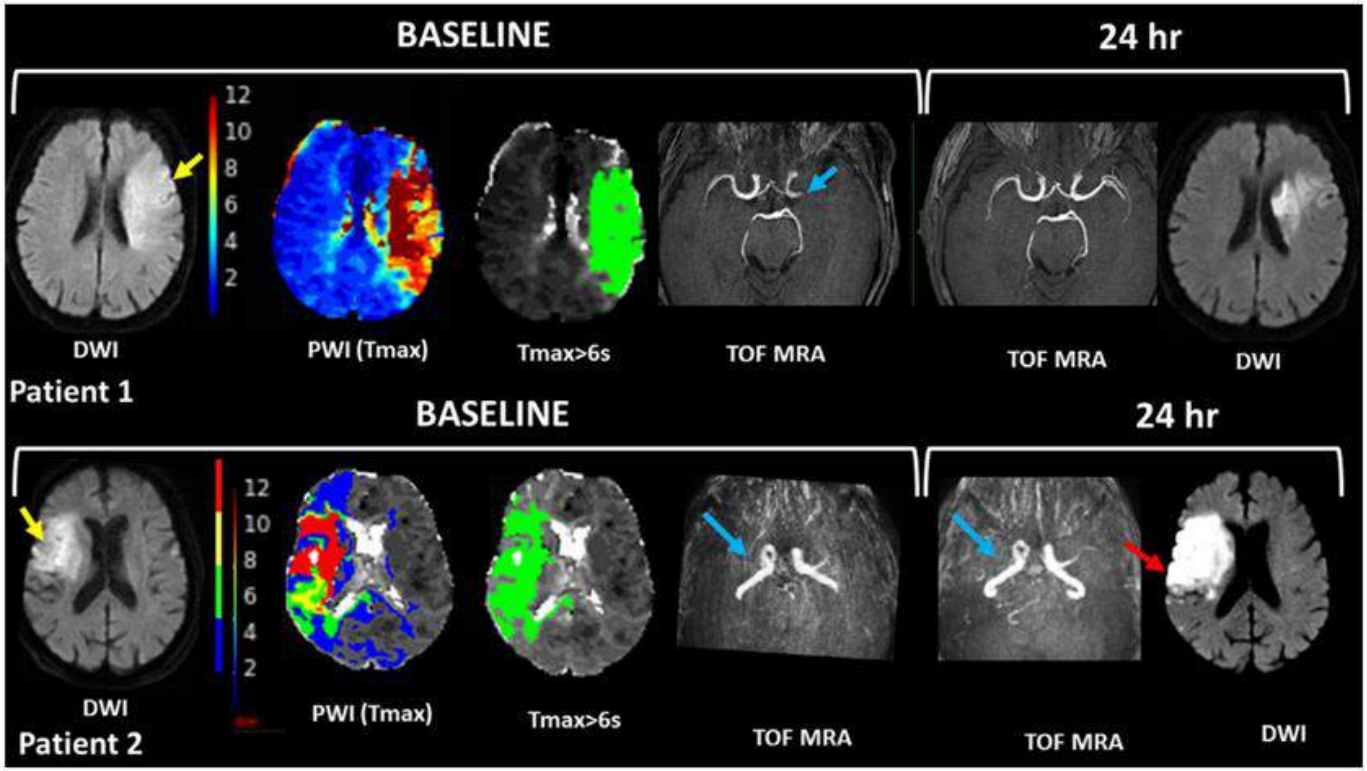


FIGURE 4 Set of serial MRI images (shown for one illustrative cut only) obtained on admission in two patients with acute proximal MCA occlusion ('baseline') and at the 24 h follow-up session ('24 h'), illustrating the widely divergent fate of the penumbra depending on occurrence of early recanalization. Patient 1 had severe neurological deficit on admission (NIHSS = 21) and DWI showed an already extensive ischaemic lesion with faint borders (yellow arrow). Perfusion-weighted imaging (PWI) generated T_{max} images showed a markedly delayed perfusion lesion with T_{max} > 6 s, that is, the penumbra threshold, involving the entire MCA territory well beyond the DWI lesion (a 'mismatch'). The automated perfusion software generated a map of T_{max} > 6 s (green blob). Time-of-flight magnetic resonance angiography (TOF-MRA) demonstrated proximal left MCA occlusion (blue arrow). The patient was thrombolysed and immediately taken to the angio suite for thrombectomy, which resulted in complete recanalization 4 h 25 min after stroke onset. The 24 h follow-up DWI showed partial reversal of the lesion, and the MRA showed persistent complete recanalization. The 24 h NIHSS was down to 3. In patient 2 (same layout), there was proximal left MCA occlusion with marked DWI-PWI mismatch. NIHSS was 18. The patient received bridging therapy (i.e., thrombolysis followed by thrombectomy), which unfortunately was unsuccessful. Accordingly, the proximal right MCA occlusion was unchanged on 24 h MRA. Note the marked posterior extension of the DWI lesion encompassing part of the initial penumbra at the 24 h time point (red arrow). NIHSS was unchanged. Courtesy: Professor Catherine Oppenheim and Dr Wagih Ben Hassen [Colour figure can be viewed at wileyonlinelibrary.com]

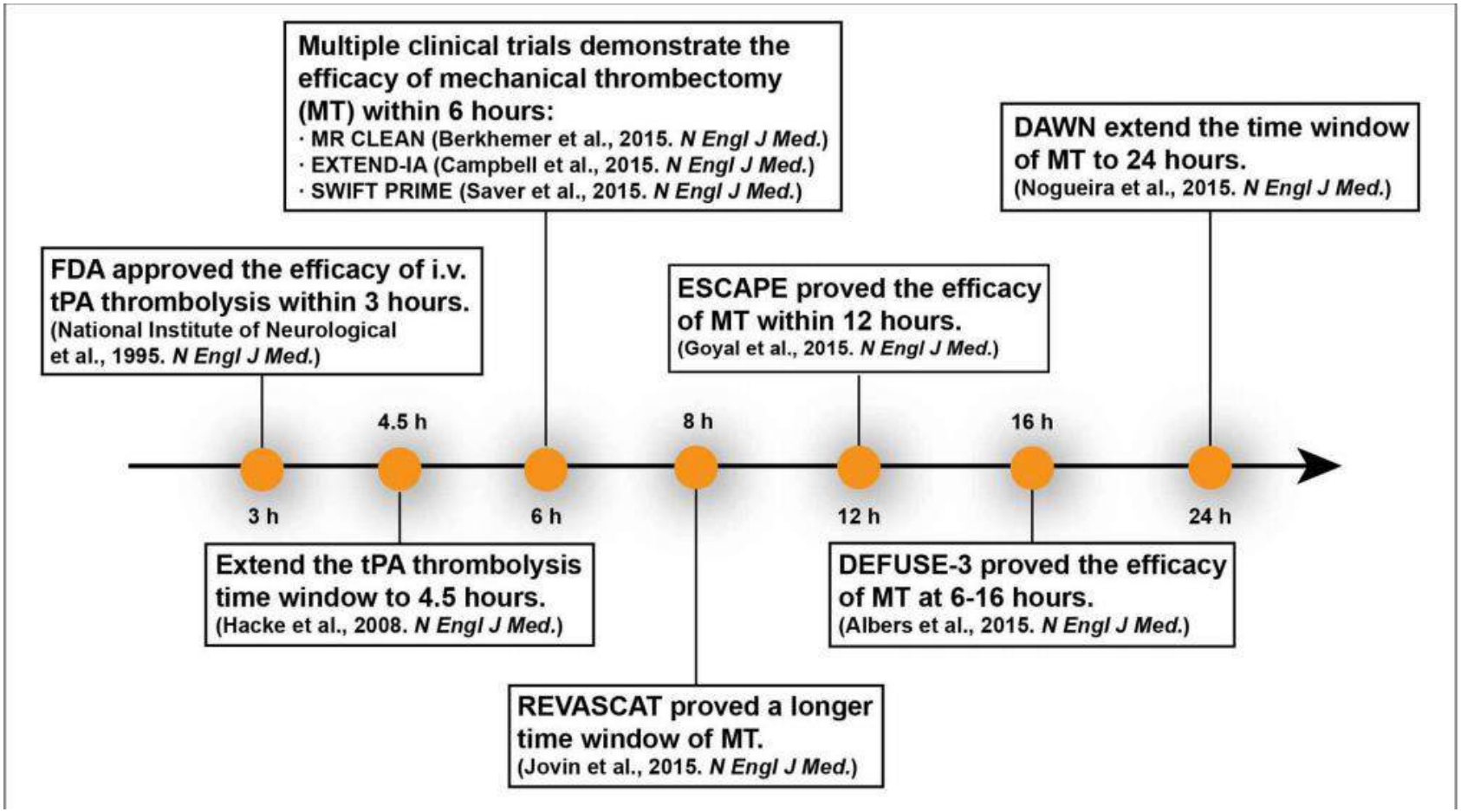

Multiple clinical trials demonstrate the efficacy of mechanical thrombectomy (MT) within 6 hours:
· MR CLEAN (Berkhemer et al., 2015. N Engl J Med.)
· EXTEND-IA (Campbell et al., 2015. N Engl J Med.)
· SWIFT PRIME (Saver et al., 2015. N Engl J Med.)
DAWN extend the time window of MT to 24 hours.
(Nogueira et al., 2015. N Engl J Med.)
FDA approved the efficacy of i.v. tPA thrombolysis within 3 hours.
(National Institute of Neurological et al., 1995. N Engl J Med.)
ESCAPE proved the efficacy of MT within 12 hours.
(Goyal et al., 2015. N Engl J Med.)
3 h
4.5 h
6 h
8 h
12 h
16 h
24 h
Extend the tPA thrombolysis time window to 4.5 hours.
(Hacke et al., 2008. N Engl J Med.)
DEFUSE-3 proved the efficacy of MT at 6-16 hours.
(Albers et al., 2015. N Engl J Med.)
REVASCAT proved a longer time window of MT.
(Jovin et al., 2015. N Engl J Med.)

TABLE 1 | Imaging modalities used in the key clinical trials to expand the therapeutic window of ischemic stroke.

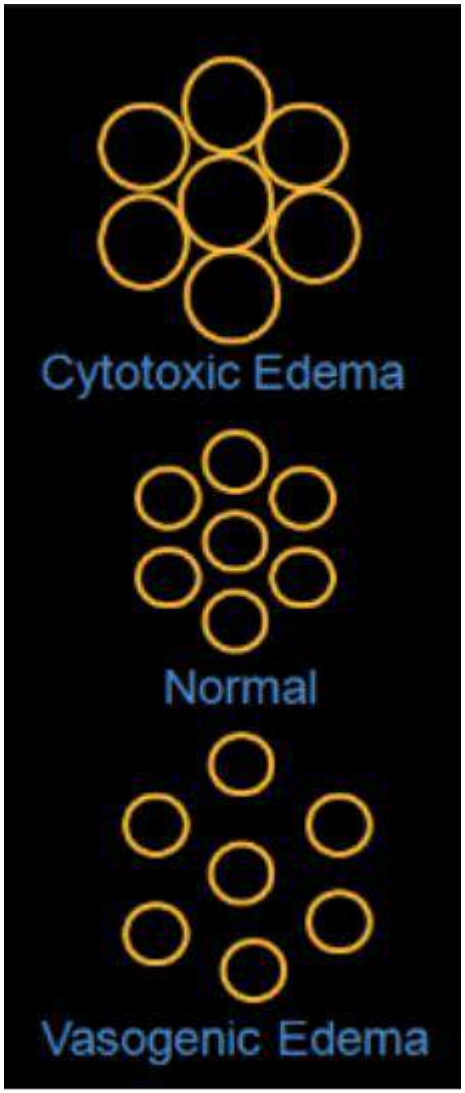
Study	Sample size	Time window	Imaging modalities	Treatment	Implications
EPITHET	101	3–6 h after onset	PWI/ DWI	Alteplase or placebo	Alteplase increased Reperfusion and neurological outcome at 90 days
ECASS III	821	3–4.5 h after onset	CT or MRI	Alteplase or placebo	Alteplase improved neurological outcome at 90 days
MR CLEAN	500	6 h after onset	CTA or MRA	Intraarterial treatment or standard care alone	Intraarterial treatment improved neurological outcome at day 90
EXTEND-IA	70	6 h after onset	CTP	Alteplase with thrombectomy or alteplase alone	Thrombectomy improved reperfusion, early neurologic recovery, and functional outcome
SWIFT PRIME	833	6 h after onset	CTP, or PWI/DWI	tPA, or tPA with endovascular thrombectomy	Thrombectomy showed more effective recanalization than tPA alone
REVASCAT	206	8 h after onset	CT, DWI	Thrombectomy or standard care alone	Thrombectomy reduced the severity of disability
ESCAPE	316	12 h after onset	CT, CTA	Thrombectomy plus standard care or standard care alone	Endovascular thrombectomy benefited the patients with moderate-to-severe ischemic stroke.
DEFUSE-3	182	6–16 h after onset	CTP, PWI/DWI	Thrombectomy plus standard care or standard care alone	Thrombectomy resulted in better functional outcomes than standard medical therapy alone
DOWN	206	6–24 h after onset	DWI, CTP	Thrombectomy plus standard care or standard care alone	Thrombectomy improved the outcomes at 90 days
WAKE UP	503	4.5 h to unknown time of onset	DWI, FLAIR	Alteplase or placebo	Alteplase improved functional outcome at 90 days

İnmede Nörogörüntüleme

- AHA/ASA 2018/9 guideline: DWI daha sensitif ama rutin kullanımı maliyet-etkin değil
- DWI,MR perfüzyon: 6-24 saat arası anterior sirkulasyon LVO'larda seçili hastalarda önerilir
- Stroke protokolü:
  - DWI/ADC, T2 flair, T2*/SWI, MRA, MRP
    - Hemorajiyi dışlama
    - Erken iskemik değişiklikleri saptama
    - Susceptibility vessel sign varlığı
    - Okluzyonu lokalize etme
    - Kurtarılabilir dokuyu tanımlama

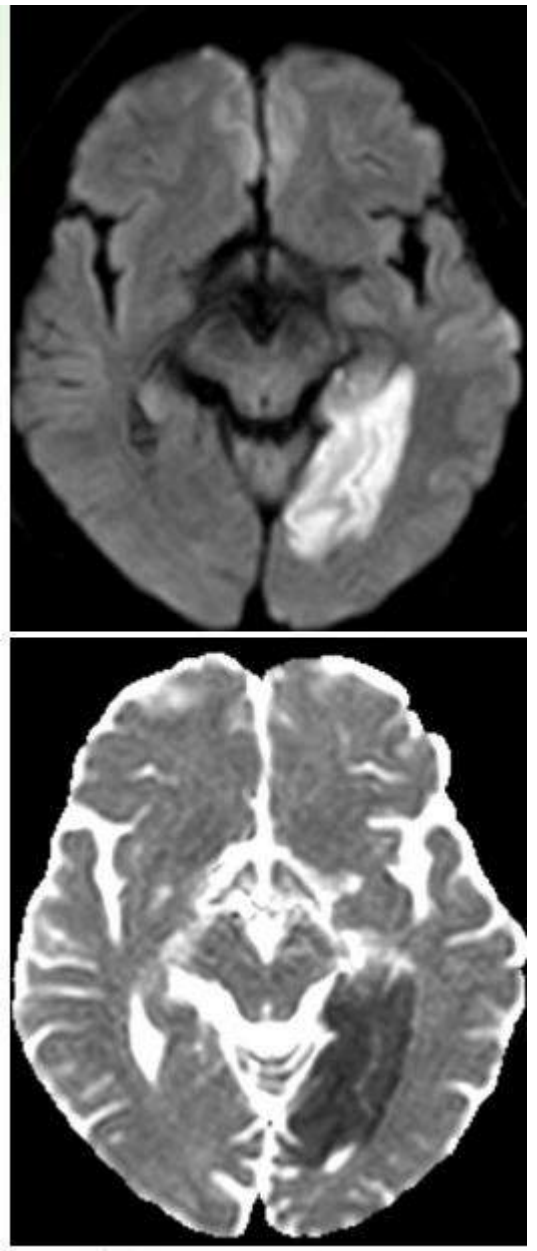
MRI DWI/ADC

- Voxeldeki su moleküllerinin Random Brownian hareketine dayanır
  - Yüksek hücre içeriği ve hücresel ödem düşük difüzyon gösterir
- Beyin iskemisi=sitotoksik ödem
  - Na+/K+ pompası çalışmaması sonucu →Na hücre içine→Cl- eşlik ederek osmotik gradient ile suyun hücre içine girişi
- BT ile kıyasla çok *küçük ve erken* enfarktlara daha sensitif
  - Dakikalar içinde yüksek sinyal
  - 3-30 dk içinde pozitif
- ADC-DWI' den hesaplanan difüzyon büyüklük ölçümüdür, aslında difüzyon derecesini gösteren bir parametrik haritadır



DWI/ADC-İskeminin Zamansallığı

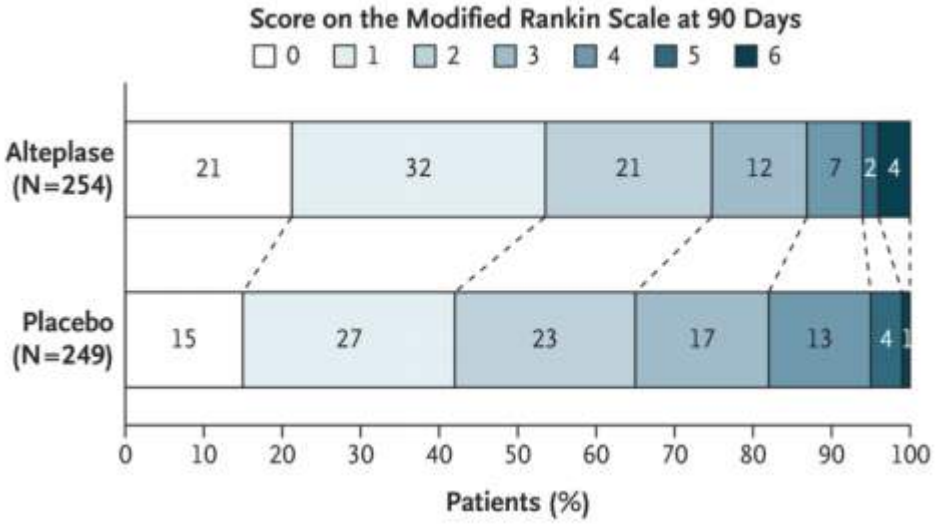
- Akut(0-7 g)
  - ADC 1-4 gün maksimal azalma
- Subakut (1-3 h)
- Kronik(>3 h)



T2 FLAIR

- BOS dan sinyalleri kaldırarak oluşan görüntü
- 6-12 saat içinde pozitif sinyaller(DWI/FLAIR mismatch)
- Yavaş akım flow void kaybı olarak görülebilir

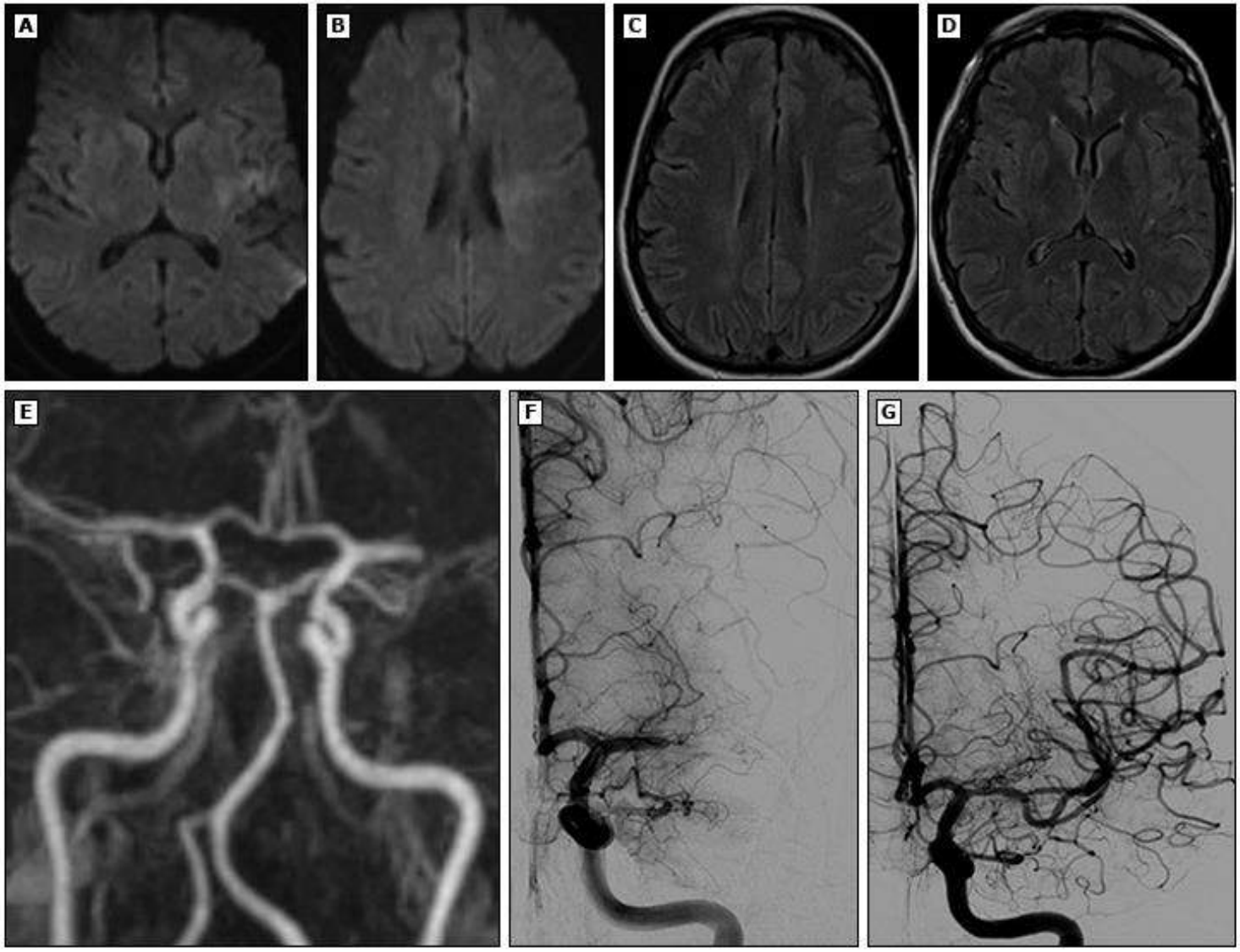
DWI/FLAIR mismatch



- WAKE-UP çalışması
  - Multisenter, randomize, plasebo kontrollü
  - Başlangıç zamanı bilinmeyen inmlerede alteplazın tedavi etkisi
  - 90. gün mRS 0-1 %53 vs %42
  - Sayısal daha fazla ölüm (10/3) ve anlamlığa ulaşan PH2 (10/1)
- DWI/FLAIR=doku penceresi(tissue window)

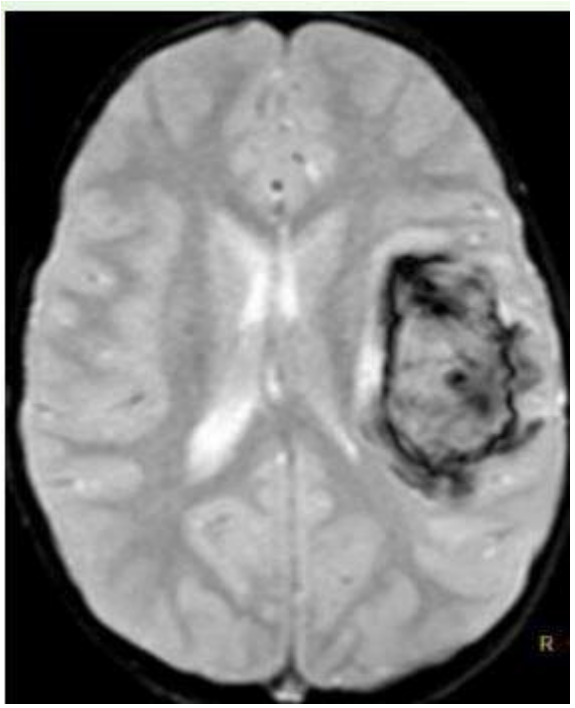
3. In patients with AIS who awake with stroke symptoms or have unclear time of onset > 4.5 hours from last known well or at baseline state, MRI to identify diffusion-positive FLAIR-negative lesions can be useful for selecting those who can benefit from IV alteplase administration within 4.5 hours of stroke symptom recognition.	**IIa**	**B-R**

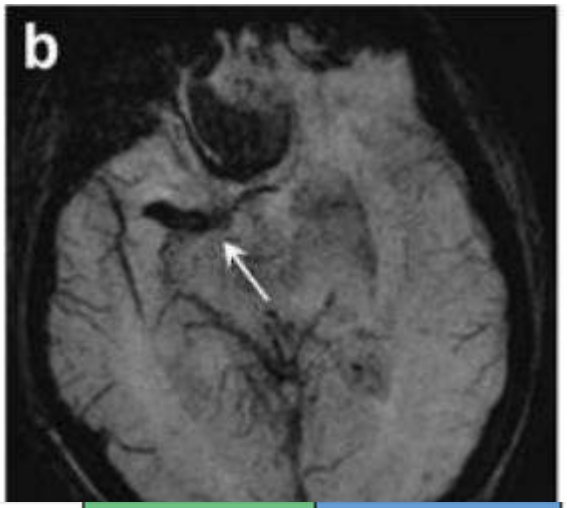
The WAKE-UP trial (Efficacy and Safety of MRI-based Thrombolysis in Wake-Up Stroke) randomized 503 patients with AIS who awoke with stroke or had unclear time of onset >4.5 hours from last known well and could be treated with IV alteplase within 4.5 hours of stroke symptom recognition. Eligibility required MRI mismatch between abnormal signal on DW-MRI and no visible signal change on FLAIR. DW-MRI lesions larger than one-third of the territory of the middle cerebral artery (MCA), NIHSS score >25, contraindication to treatment with alteplase, or planned thrombectomy were all exclusions. The trial was terminated early for lack of funding before the designated 800 patients were randomized. Ninety-four percent were wake-up strokes. Median NIHSS score was 6. Median time from last known well was slightly over 10 hours. At baseline, one-third of the patients had vessel occlusion on time-of-flight MRA, and three-quarters of the FLAIR lesions were <9 mL. The end point of an mRS score of 0 to 1 at 90 days was achieved in 53.3% of the IV alteplase group and in 41.8% of the placebo group (P=0.02).[88]


A
B
C
D
E
F
G

T2*/GRE/SWI

- lokal manyetik alana etkileri olan bileşikler nedeni ile ortaya çıkan sekanslar
- Kan ürünleri, kalsiyum ve para/dia/ferro -manyetik bileşikler
- Trombüs saptanması=Susceptibility vessel sign





4. Magnetic resonance (MR) imaging (MRI) is effective to exclude ICH before IV alteplase administration.	I	B-NR

MRA

- TOF tekniği- kontrastsız,akım yönü ve hızına duyarlı
- Darlık derecesi ve uzunluğunu overestimate
- Faz kontrast anjiografi: venöz trombozda
- CE-MRA- kontrastlı kan akımından etkilenmeyen,yavaş akımda daha az artefakt(VA-CCA/ICA)

MRA/CTA

MRA

- Kontrastsız
- Hemodinami bilgisi

- Limitli ulaşım
- CE-MRA Artefaktlar

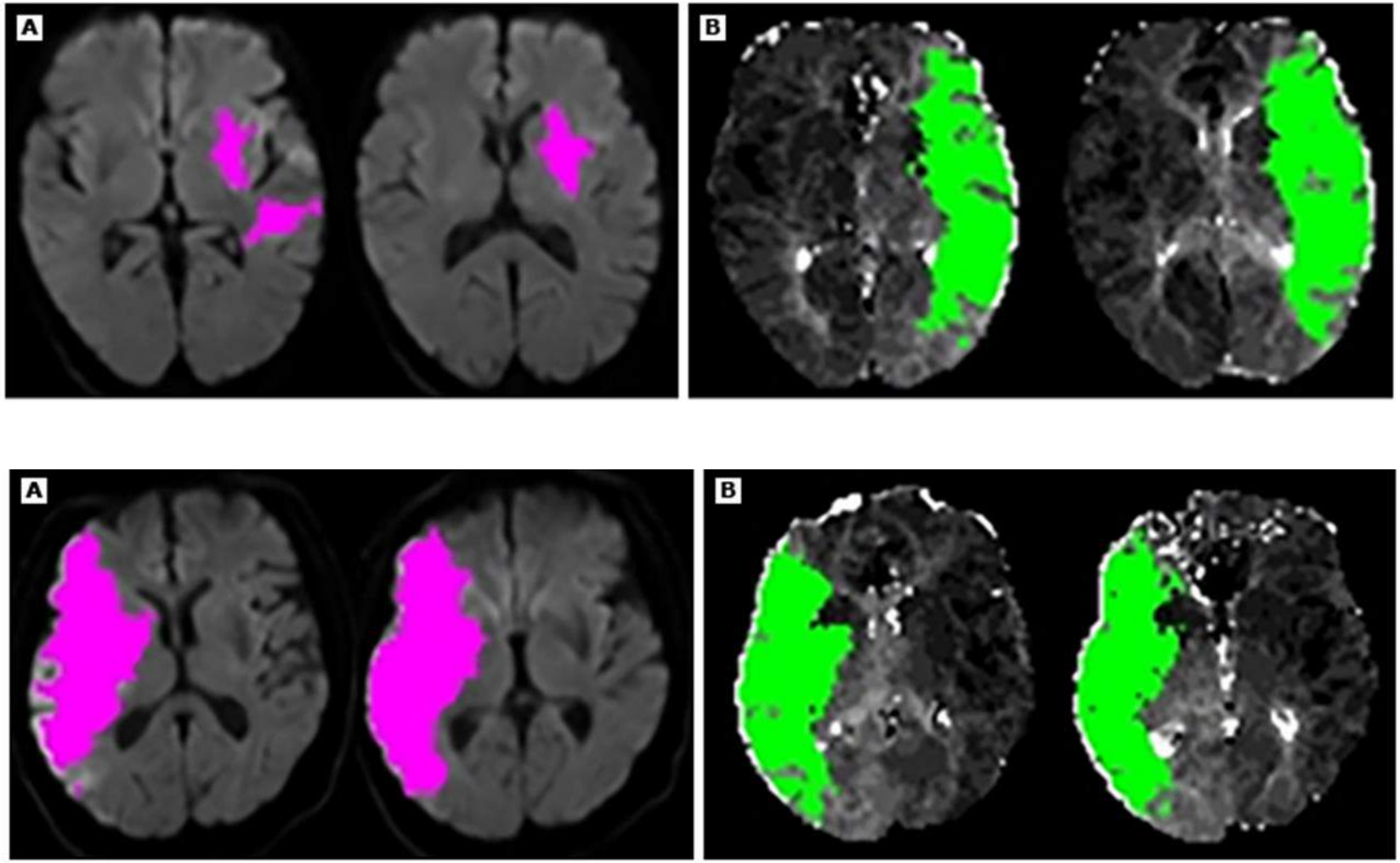
CTA

- Yaygın ulaşım
- Hızlı veri işlemleme
- Akımdan bağımsız
- DSA ya yakın sonuçlar

Kontrast bağımlı

Radyasyon

MR Perfüzyon



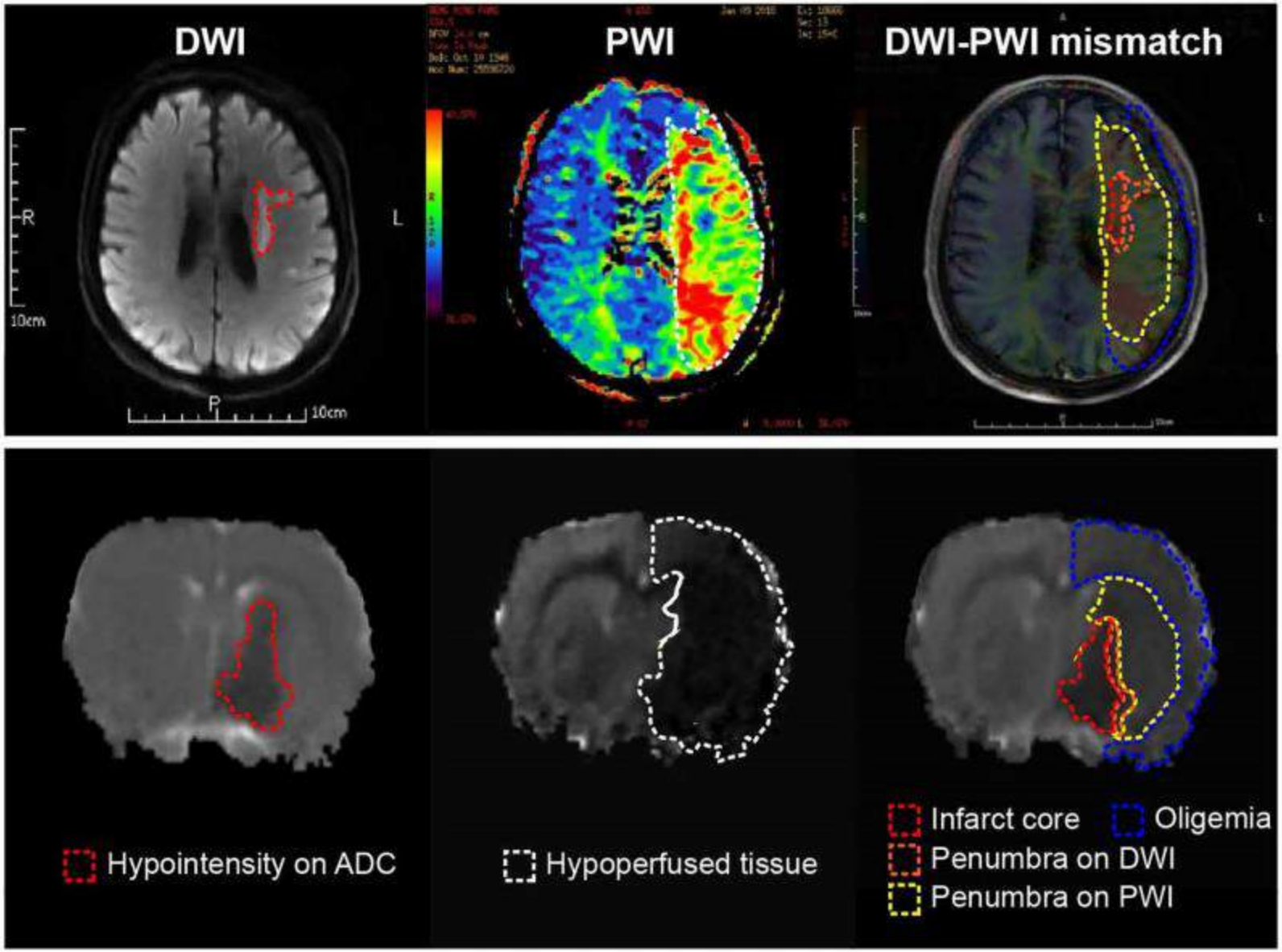


FIGURE 2 | Current concept of the ischemic penumbra. Both clinical (Upper) and experimental (Below) MRI data showed early abnormality on DWI equals the infarct core plus a part of tissue at risk (penumbra), and the perfusion deficiency on PWI includes part of the region of benign oligemia. MRI, magnetic resonance imaging; PWI, perfusion-weighted imaging.

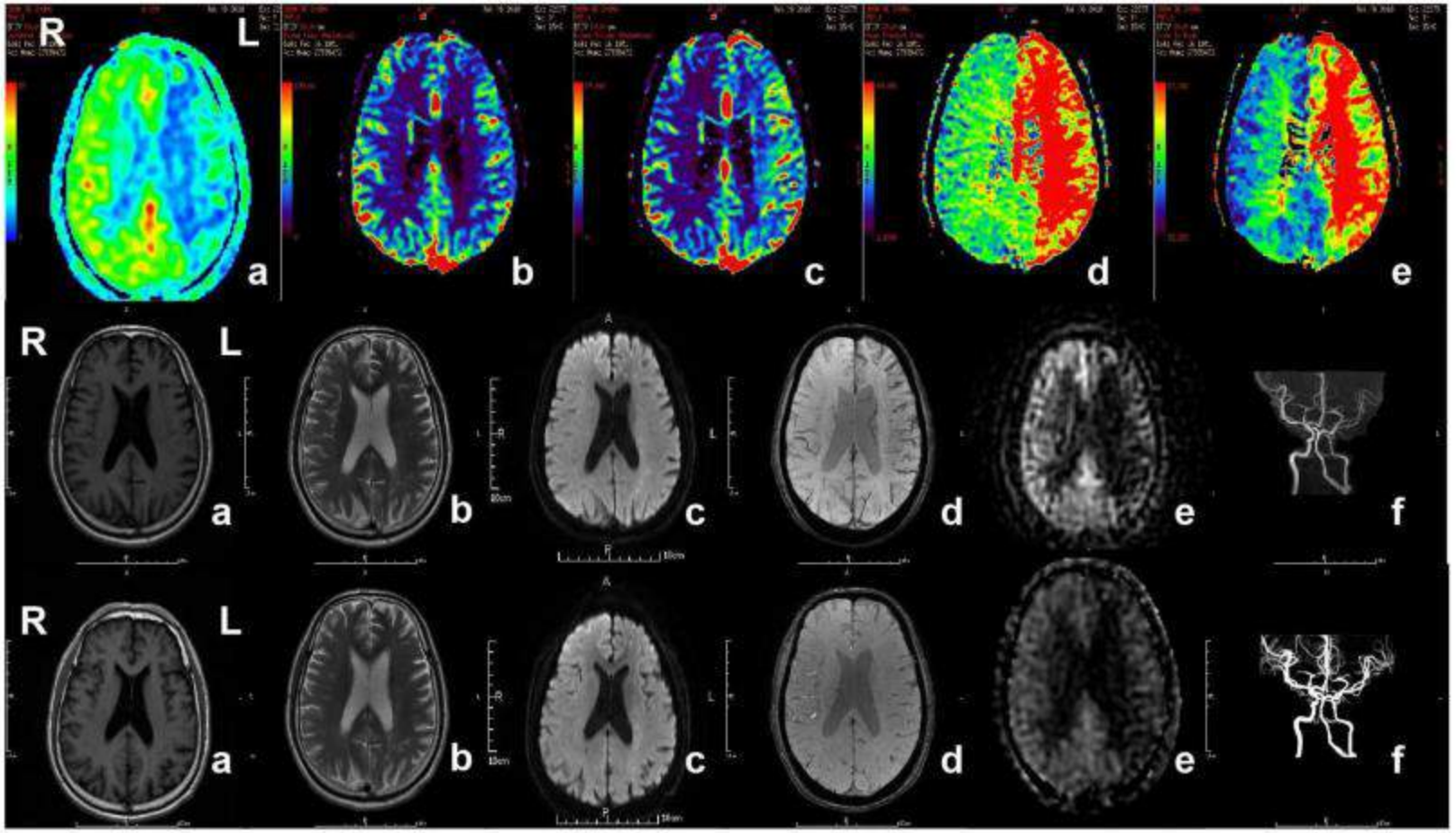
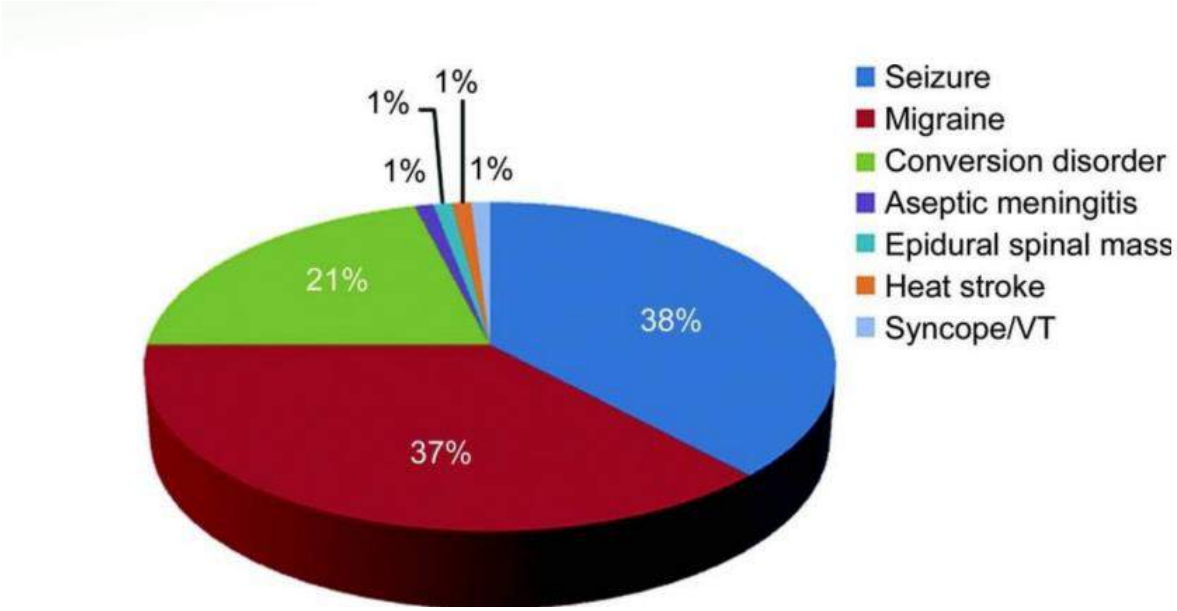


FIGURE 3 | MR imaging of the patient with acute ischemic stroke. The patient, 71-year-old male, suffered from weakness of right limbs, alalia and was unable to walk 3 h prior to the imaging. Medical history included hypertension, diabetes and varicosity of both lower extremities. Physical examination showed right facial paralysis, the muscle strength of right limbs was grade I, right Babinski sign (+), Chaddock sigh (+), and NIHSS score was 13. The diagnosis of the patient is acute ischemic stroke. The patient was given multimodal MRI and MRA before and after recanalization. The first row showed perfusion-weighted imaging. a and b, Lower CBF in left cerebral hemisphere. c, Higher CBV in left cerebral hemisphere. d, Longer MTT in left cerebral hemisphere. e, Longer TTP in left cerebral hemisphere. The second row and third row showed MRI and MRA before recanalization and after recanalization, respectively. a, b, and c, In the left frontal lobe and lateral ventricle had sporadic dots with slightly longer T1 signal, longer T2 signal higher signal, respectively, in T1WI, T2WI, DWI. d, No cerebral microbleeds in SWI. e, Original ASL. f, MRA showed the intracranial segment of the left internal carotid artery and the left middle cerebral artery were significantly narrow in the second row, while recanalization got in left internal carotid artery and middle cerebral artery. MR, magnetic resonance; MRA, magnetic resonance angiography; SWI, susceptibility weighted imaging; ASL, arterial spin labeling; CBV, cerebral blood volume; CBF, cerebral blood flow; TTP, time to peak; MTT, mean transit time.

Mimikleri dışlama

- 3-10%
- Nöbet,migren,hipoglisemi,konversiyon,senkop,VT.



3 çalışma

- Dawn
- Defuse 3
- Wake-Up

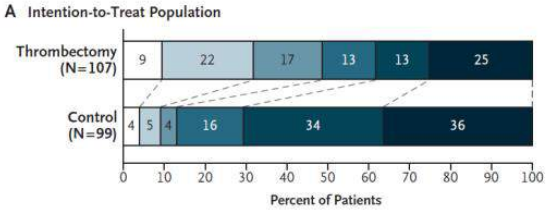
1. When selecting patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation, obtaining CTP or DW-MRI, with or without MRI perfusion, is recommended to aid in patient selection for mechanical thrombectomy, but only when patients meet other eligibility criteria from one of the RCTs that showed benefit from mechanical thrombectomy in this extended time window.	I	A

The DAWN trial (Clinical Mismatch in the Triage of Wake Up and Late Presenting Strokes Undergoing Neurointervention With Trevo) used clinical-core mismatch (a combination of age-adjusted NIHSS score and age-adjusted core infarct size on CTP or DW-MRI) as an eligibility criterion to select patients with large anterior circulation vessel occlusion for mechanical thrombectomy between 6 and 24 hours from last known normal. This trial demonstrated an overall benefit in functional outcome at 90 days in the treatment group (mRS score 0–2, 49% versus 13%; adjusted difference, 33% [95% CI, 21–44]; posterior probability of superiority >0.999).[51] The DEFUSE 3 trial (Diffusion and Perfusion Imaging Evaluation for Understanding Stroke Evolution) used perfusion-core mismatch and maximum core size as imaging criteria to select patients with large anterior circulation occlusion 6 to 16 hours from last seen well for mechanical thrombectomy. This trial showed a benefit in functional outcome at 90 days in the treated group (mRS score 0–2, 44.6% versus 16.7%; RR, 2.67 [95% CI, 1.60–4.48]; $P<0.0001$).[52] Benefit was independently demonstrated for the subgroup of patients who met DAWN eligibility criteria and for the subgroup who did not. DAWN and DEFUSE 3 are the only RCTs showing benefit of mechanical thrombectomy >6 hours from onset. Therefore, only the eligibility criteria from one or the other of these trials should be used for patient selection. Although future RCTs may demonstrate that additional eligibility criteria can be used to select patients who benefit from mechanical thrombectomy, at this time, the DAWN or DEFUSE 3 eligibility should be strictly adhered to in clinical practice.[51,52]

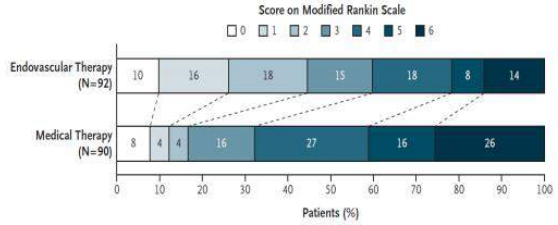
>6 saat MTx

- DAWN DWI ya da CTP /klinik mismatch

N Engl J Med. 2018 Jan 4;378(1):11-21



N Engl J Med. 2018 Feb 22;378(8):708-718



- DEFUSE.3 otomatize kor/perfüzyon mismatch

defuse·3

DWI or CTP – clinical mismatch

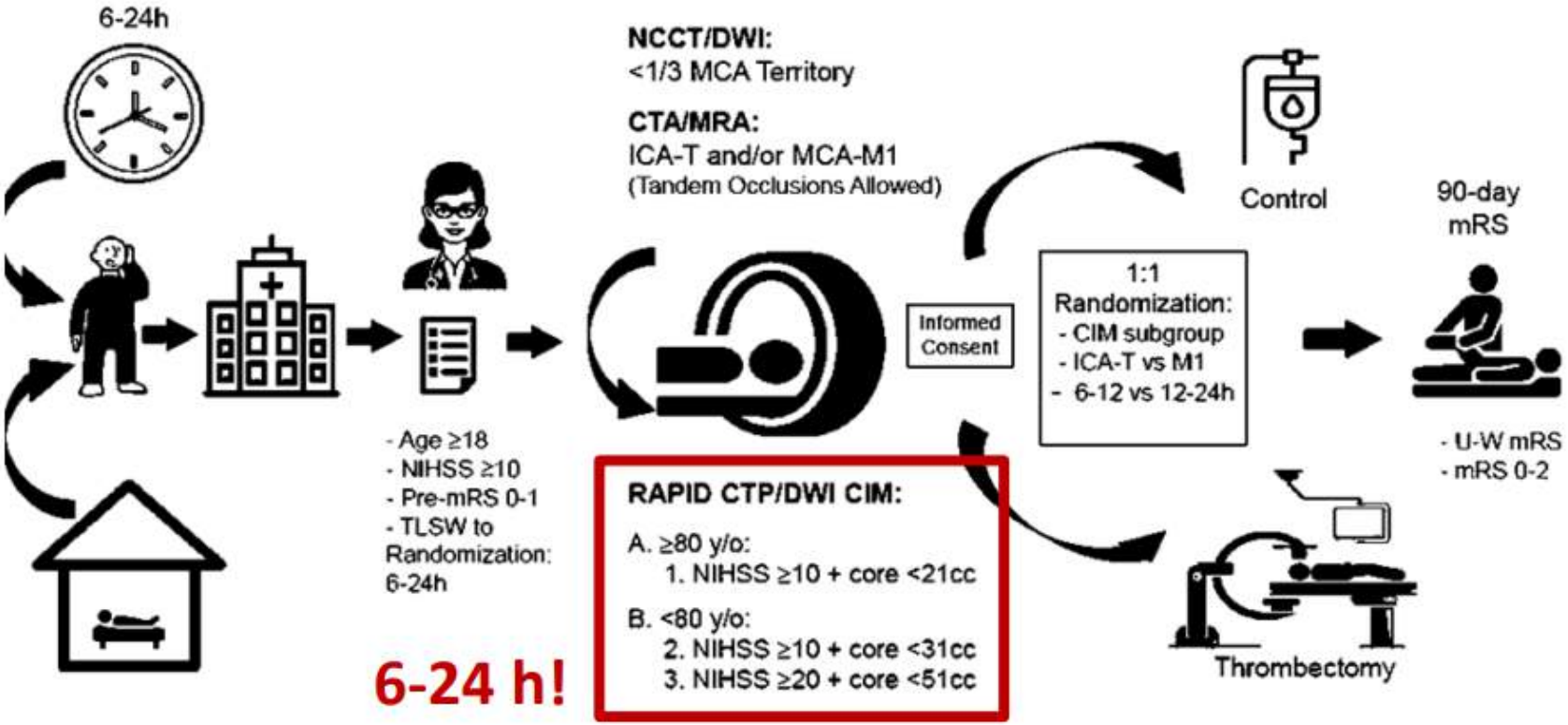
- - 0-<21 cc core infarct and NIHSS ≥ 10 (and age ≥ 80 years old)
- - 0-<31 cc core infarct and NIHSS ≥ 10 (and age < 80 years old)
- - 31 cc to <51 cc core infarct and NIHSS ≥ 20 (and age < 80 years old)

- NIHSS ≥ 10

CTP or DWI

- Core <70 ml,
  mismatch ratio ≥1.8,
  mismatch volume ≥ 15 ml

- NIHSS ≥ 6



<20-50 mL ischemic core

Nogueira RG et al. N Engl J Med. 2018;378(1):11-21.

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**	New recommendation.
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**	New recommendation.

The DAWN trial used clinical imaging mismatch (a combination of NIHSS score and imaging findings on CTP or DW-MRI) as eligibility criteria to select patients with large anterior circulation vessel occlusion for treatment with mechanical thrombectomy between 6 and 24 hours from last known normal. This trial demonstrated an overall benefit in function outcome at 90 days in the treatment group (mRS score 0–2, 49% versus 13%; adjusted difference, 33%; 95% CI, 21–44; posterior probability of superiority >0.999).[108] In DAWN, there were few strokes with witnessed onset (12%).The DEFUSE 3 trial used perfusion-core mismatch and maximum core size as imaging criteria to select patients with large anterior circulation occlusion 6 to 16 hours from last seen well for mechanical thrombectomy. This trial showed a benefit in functional outcome at 90 days in the treated group (mRS score 0–2, 44.6% versus 16.7%; RR, 2.67; 95% CI, 1.60–4.48; $P<0.0001$).[109] Benefit was independently demonstrated for the subgroup of patients who met DAWN eligibility criteria and for the subgroup who did not. DAWN and DEFUSE 3 are the only RCTs showing benefit of mechanical thrombectomy >6 hours from onset. Therefore, only the eligibility criteria from these trials should be used for patient selection. Although future RCTs may demonstrate that additional eligibility criteria can be used to select patients who benefit from mechanical thrombectomy, at this time, the DAWN and DEFUSE-3 eligibility should be strictly adhered to in clinical practice.

3. IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 minutes with initial 10% of dose given as bolus over 1 minute) administered within 4.5 hours of stroke symptom recognition can be beneficial in patients with AIS who awake with stroke symptoms or have unclear time of onset >4.5 hours from last known well or at baseline state and who have a DW-MRI lesion smaller than one-third of the MCA territory and no visible signal change on FLAIR.	**IIa**	**B-R**
The WAKE-UP RCT randomized 503 patients with AIS who awoke with stroke or had unclear time of onset and could be treated with IV alteplase within 4.5 hours of stroke symptom recognition. Eligibility required MRI mismatch between abnormal signal on DW-MRI and no visible signal change on FLAIR. DW-MRI lesions larger than one-third of the territory of the MCA, NIHSS score >25, contraindication to treatment with alteplase, or planned thrombectomy were all exclusions. Ninety-four percent were wake-up strokes. Median NIHSS score was 6. Median time from last known well to symptom recognition was ≈7 hours and to alteplase administration slightly over 10 hours. The primary end point of an mRS score 0 to 1 at 90 days was achieved in 53.3% of the alteplase group and in 41.8% of the placebo group (*P*=0.02). Only 20% had LVO of the intracranial internal carotid or proximal middle cerebral arteries.[88]		

Wake-up and unknown time of onset	IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 min with initial 10% of dose given as bolus over 1 min) administered within 4.5 h of stroke symptom recognition can be beneficial in patients with AIS who awake with stroke symptoms or have unclear time of onset >4.5 h from last known well or at baseline state and who have a DW-MRI lesion smaller than one-third of the MCA territory and no visible signal change on FLAIR. (*COR IIa; LOE B-R*)‡

- WAKE-UP

The NEW ENGLAND JOURNAL of MEDICINE

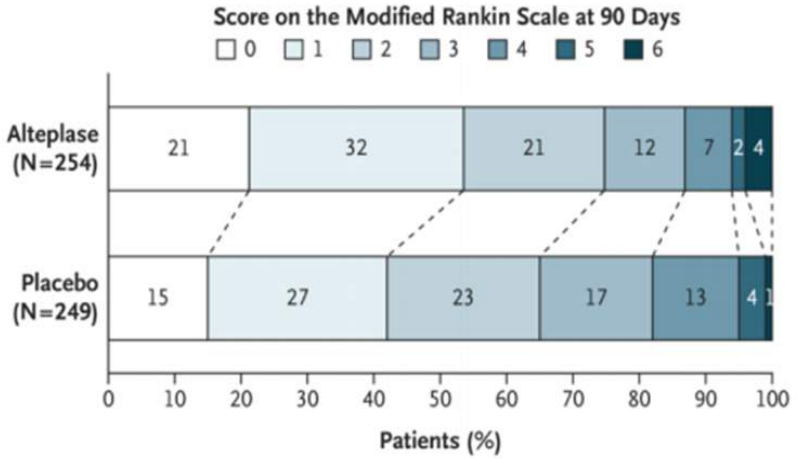
ESTABLISHED IN 1812 AUGUST 16, 2018 VOL. 379 NO. 7

MRI-Guided Thrombolysis for Stroke with Unknown Time of Onset

G. Thomalla, C.Z. Simonsen, F. Boutitie, G. Andersen, Y. Berthezene, B. Cheng, B. Cheripelli, T.-H. Cho, F. Fazekas, J. Fiehler, I. Ford, I. Galinovic, S. Gellissen, A. Golsari, J. Gregori, M. Günther, J. Guibernau, K.G. Häusler, M. Hennerici, A. Kemmling, J. Marstrand, B. Modrau, L. Neeb, N. Perez de la Ossa, J. Puig, P. Ringleb, P. Roy, E. Scheel, W. Schonewille, J. Serena, S. Sunaert, K. Villringer, A. Wouters, V. Thijs, M. Ebinger, M. Endres, J.B. Fiebach, R. Lemmens, K.W. Muir, N. Nighoghossian, S. Pedraza, and C. Gerloff, for the WAKE-UP Investigators*

Table 3. Safety Outcomes.

Outcome	Alteplase Group (N=251)	Placebo Group (N=244)	Adjusted Odds Ratio (95% CI)*	P Value
	no. (%)			
Primary†				
Death or dependency at 90 days	33 (13.5)	44 (18.3)	0.68 (0.39–1.18)	0.17
Death at 90 days	10 (4.1)	3 (1.2)	3.38 (0.92–12.52)	0.07
Secondary				
Symptomatic intracranial hemorrhage				
As defined in SITS-MOST‡	5 (2.0)	1 (0.4)	4.95 (0.57–42.87)	0.15
As defined in ECASS II§	7 (2.8)	3 (1.2)	2.40 (0.60–9.53)	0.21
As defined in ECASS III¶	6 (2.4)	1 (0.4)	6.04 (0.72–50.87)	0.10
As defined in NINDS‖	20 (8.0)	12 (4.9)	1.78 (0.84–3.71)	0.13
Parenchymal hemorrhage type 2**	10 (4.0)	1 (0.4)	10.46 (1.32–82.77)	0.03



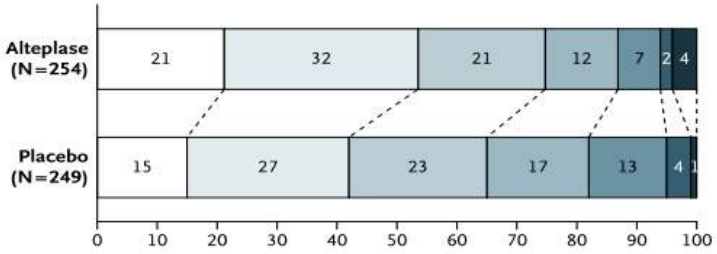
DWI-FLAIR mismatch for the identification of patients with acute ischaemic stroke within 4·5 h of symptom onset (PRE-FLAIR): a multicentre observational study

Götz Thomalla, Bastian Cheng, Martin Ebinger, Qing Hao, Thomas Tourdias, Ona Wu, Jong S Kim, Lorenz Breuer, Oliver C Singer, Steven Warach, Soren Christensen, Andras Treszl, Nils D Forkert, Ivana Galinovic, Michael Rosenkranz, Tobias Engelhorn, Martin Köhrmann, Matthias Endres, Dong-Wha Kang, Vincent Dousset, A Gregory Sorensen, David S Liebeskind, Jochen B Fiebach, Jens Fiehler, Christian Gerloff, for the STIR and VISTA Imaging Investigators

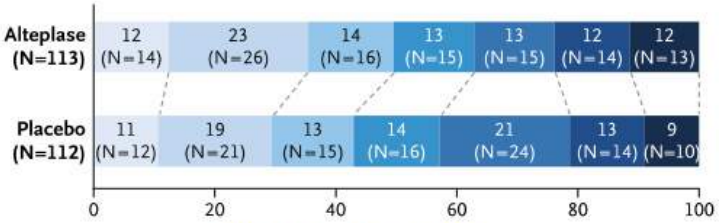
Lancet Neurol 2011; 10: 978–86

DWI-FLAIR mismatch identified patients **within 4·5 h** of symptom onset with **62%** (95% CI 57–67) sensitivity

IVT > 4.5 hrs



acOR 1.62 (1.17-2.23)



acOR 1.55 (0.96-2.49)

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 16, 2018 VOL. 379 NO. 7

MRI-Guided Thrombolysis for Stroke with Unknown Time of Onset

G. Thomalla, C.Z. Simonsen, F. Boutitie, G. Andersen, Y. Berthezene, B. Cheng, B. Cheripelli, T.-H. Cho, F. Fazekas,

WAKE UP trial

ESTABLISHED IN 1812 MAY 9, 2019 VOL. 380 NO. 19

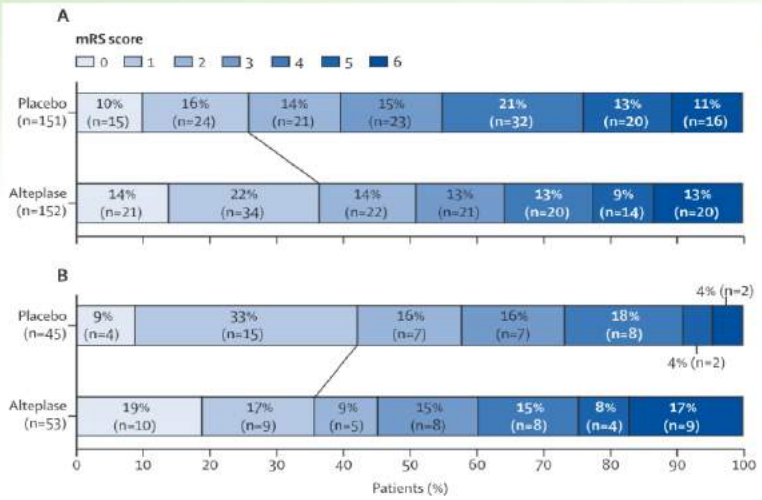
Thrombolysis Guided by Perfusion Imaging up to 9 Hours after Onset of Stroke

H. Ma, B.C.V. Campbell, M.W. Parsons, L. Churilov, C.R. Levi, C. Hsu, T.J. Kleinig, T. Wijeratne, S. Curtze,

EXTEND trial

Mismatch

No mismatch



Extending thrombolysis to 4·5–9 h and wake-up stroke using perfusion imaging: a systematic review and meta-analysis of individual patient data

Bruce C V Campbell*, Henry Ma*, Peter A Ringleb*, Mark W Parsons, Leonid Churilov, Martin Bendszus, Christopher R Levi, Chung Hsu, Timothy J Kleinig, Mark Fatar, Didier Leys, Carlos Molina, Tissa Wijeratne, Sami Curtze, Helen M Dewey, P Alan Barber, Kenneth S Butcher, Deidre A De Silva, Christopher F Bladin, Nawaf Yassi, Johannes A R P Jaff, Gagan Sharma, Andrew Bivard, Patricia M Desmond, Stefan Schwab, Peter D Schellinger, Bernard Yan, Peter J Mitchell, Joaquin Serena, Danilo Toni, Vincent Thijs, Werner Hacke†, Stephen M Davis†, Geoffrey A Donnan†, on behalf of the EXTEND, ECASS-4, and EPITHET investigators‡

Summary

Background Stroke thrombolysis with alteplase is currently recommended 0–4·5 h after stroke onset. We aimed to determine whether perfusion imaging can identify patients with salvageable brain tissue with symptoms 4·5 h or more from stroke onset or with symptoms on waking who might benefit from thrombolysis.

Methods In this systematic review and meta-analysis of individual patient data, we searched PubMed for randomised trials published in English between Jan 1, 2006, and March 1, 2019. We also reviewed the reference list of a previous systematic review of thrombolysis and searched ClinicalTrials.gov for interventional studies of ischaemic stroke. Studies of alteplase versus placebo in patients (aged ≥18 years) with ischaemic stroke treated more than 4·5 h after onset, or with wake-up stroke, who were imaged with perfusion-diffusion MRI or CT perfusion were eligible for inclusion. The primary outcome was excellent functional outcome (modified Rankin Scale [mRS] score 0–1) at 3 months, adjusted for baseline age and clinical severity. Safety outcomes were death and symptomatic intracerebral haemorrhage. We calculated odds ratios, adjusted for baseline age and National Institutes of Health Stroke Scale score, using mixed-effects logistic regression models. This study is registered with PROSPERO, number CRD42019128036.

Findings We identified three trials that met eligibility criteria (EXTEND, ECASS4-EXTEND, and EPITHET). Of the 414 patients included in the three trials, 213 (51%) were assigned to receive alteplase and 201 (49%) were assigned to receive placebo. Overall, 211 patients in the alteplase group and 199 patients in the placebo group had mRS assessment

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See Online/Comment http://dx.doi.org/10.1016/S0140-6736(19)31095-5

*Contributed equally

†Contributed equally

‡Investigators listed in the appendix

Department of Medicine and Neurology, Melbourne Brain Centre (Prof B C V Campbell PhD, Prof M W Parsons PhD, Prof L Churilov PhD, N Yassi PhD, G Sharma MCA, A Bivard PhD, Prof B Yan DMedSci, Prof S M Davis MD,

Safety outcomes	Placebo (n=152)	Alteplase (n=152)	Odds ratio (95% CI)*	p value
Death at 3 months	16/152 (11%)	20/152 (13%)	1·28 (0·60–2·73)	0·52
Symptomatic intracerebral haemorrhage§	1/152 (1%)	7/152 (5%)	7·29 (0·88–60·18)	0·07

ENDOVASKÜLER TEDAVİ ÖNCESİ KOLLATERAL DEĞERLENDİRME - CTA

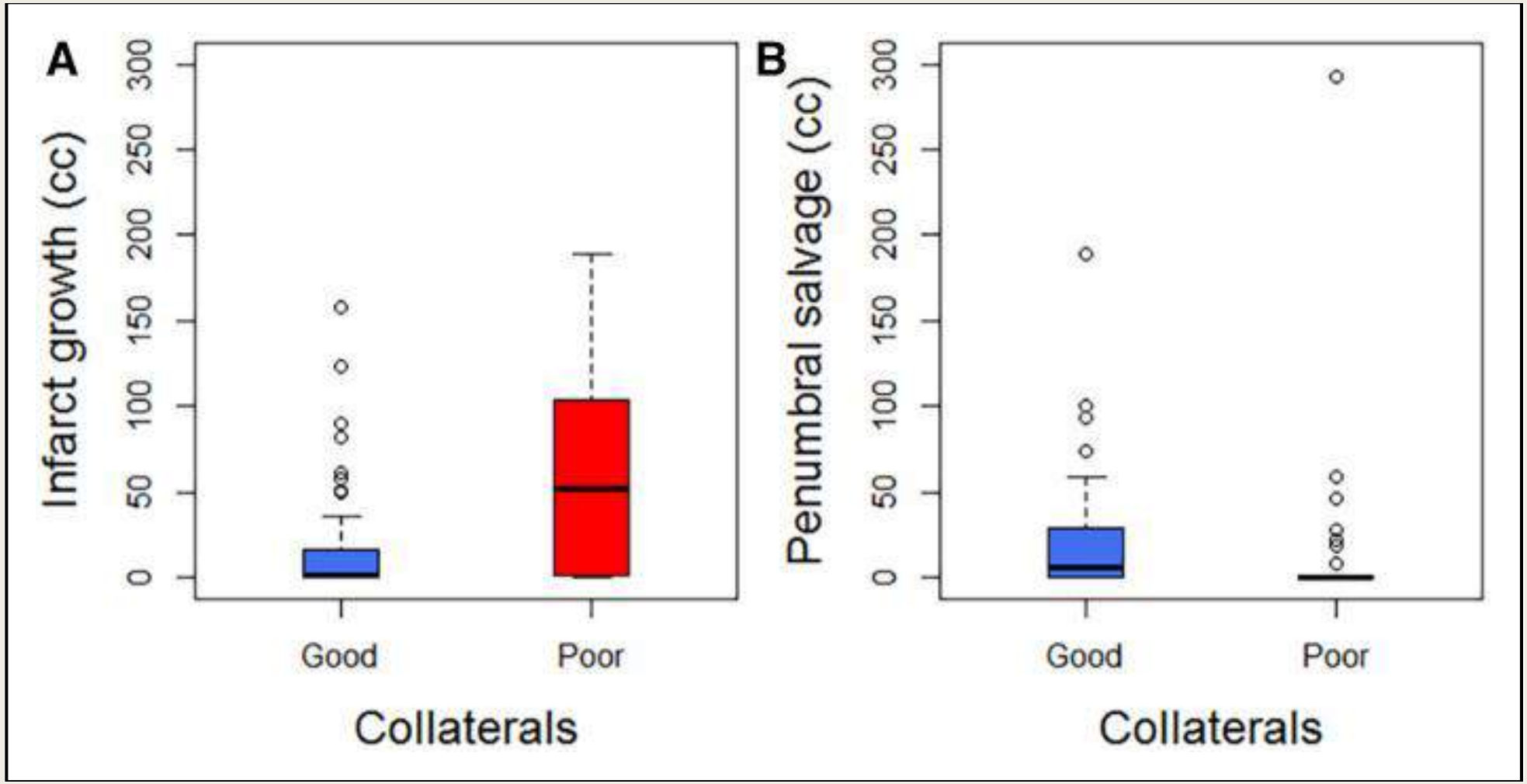
Demet Funda Baş

Collateral Clock Is More Important Than Time Clock for Tissue Fate

A Natural History Study of Acute Ischemic Strokes

Achala Vagal, MD, MS; Richard Aviv, MD; Heidi Sucharew, PhD; Mahati Reddy, MD; Qinghua Hou, MD; Patrik Michel, MD; Tudor Jovin, MD; Thomas Tomsick, MD; Max Wintermark, MD; Pooja Khatri, MD, MSc

Stroke **September 2018**



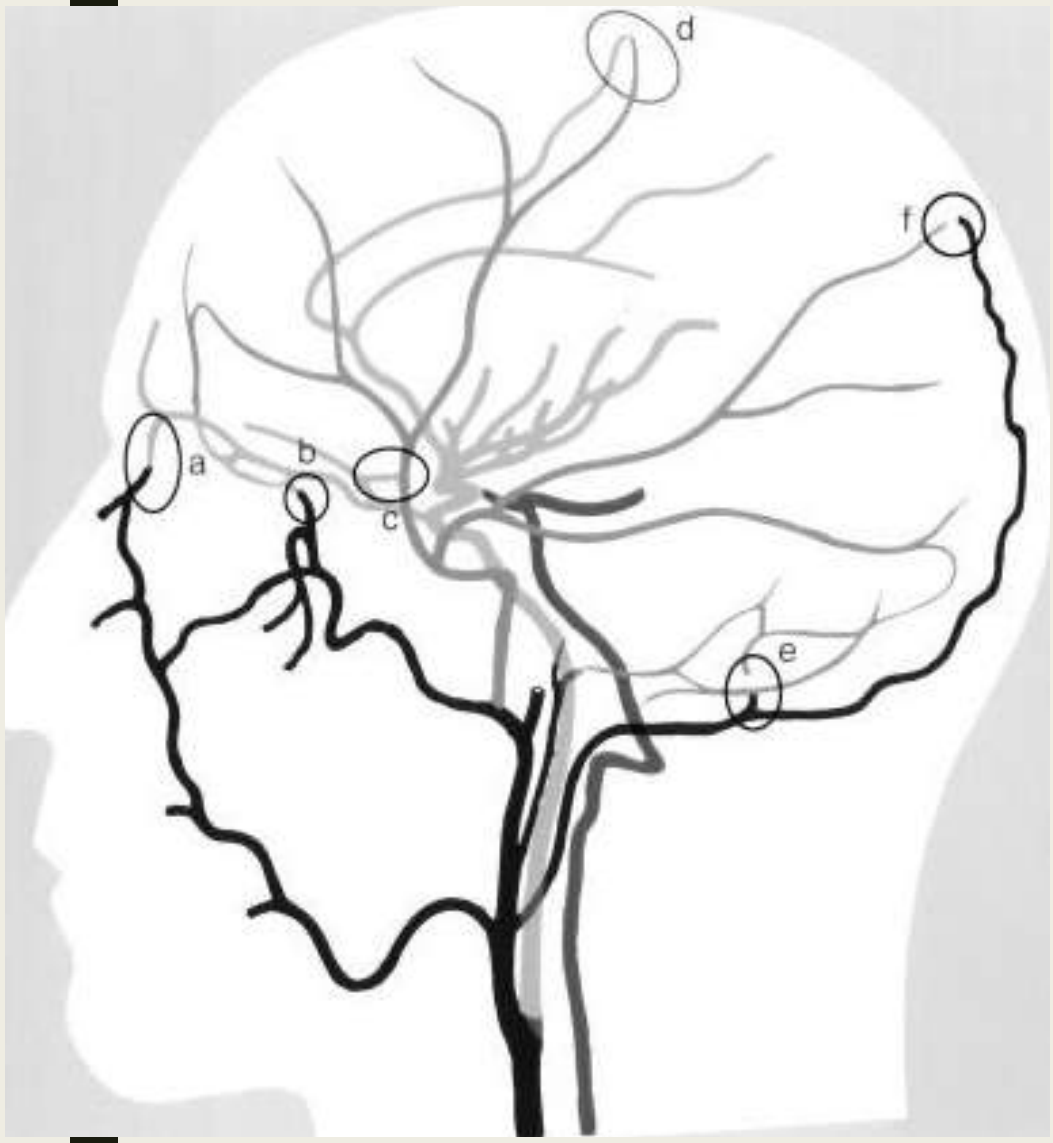
Kollateral Anatomi

- Ekstrakranial & intrakranial
- Circle of Willis
  - *Primer kollateraller*
- Oftalmik a ve leptomeningeal damarlar
  - *Sekonder kollateraller*
- MCA & ACA > MCA & PCA > PCA & ACA terminal anastomozlar

Stroke. 2003;34:2279-2284

Collateral Circulation

David S. Liebeskind, MD



- Ekstrakranial arterial kollateral sirkülasyon
  - *Facial a (a)*
  - *Maxillary a (b)*
  - *Middle meningeal a (c)*

→ *Oftalmik a*

  - *Dural arteriolar anastomozlar*
    - Middle meningela a — Mastoid foramen (e)
    - Occipital a (d) — Parietal foramen (f)

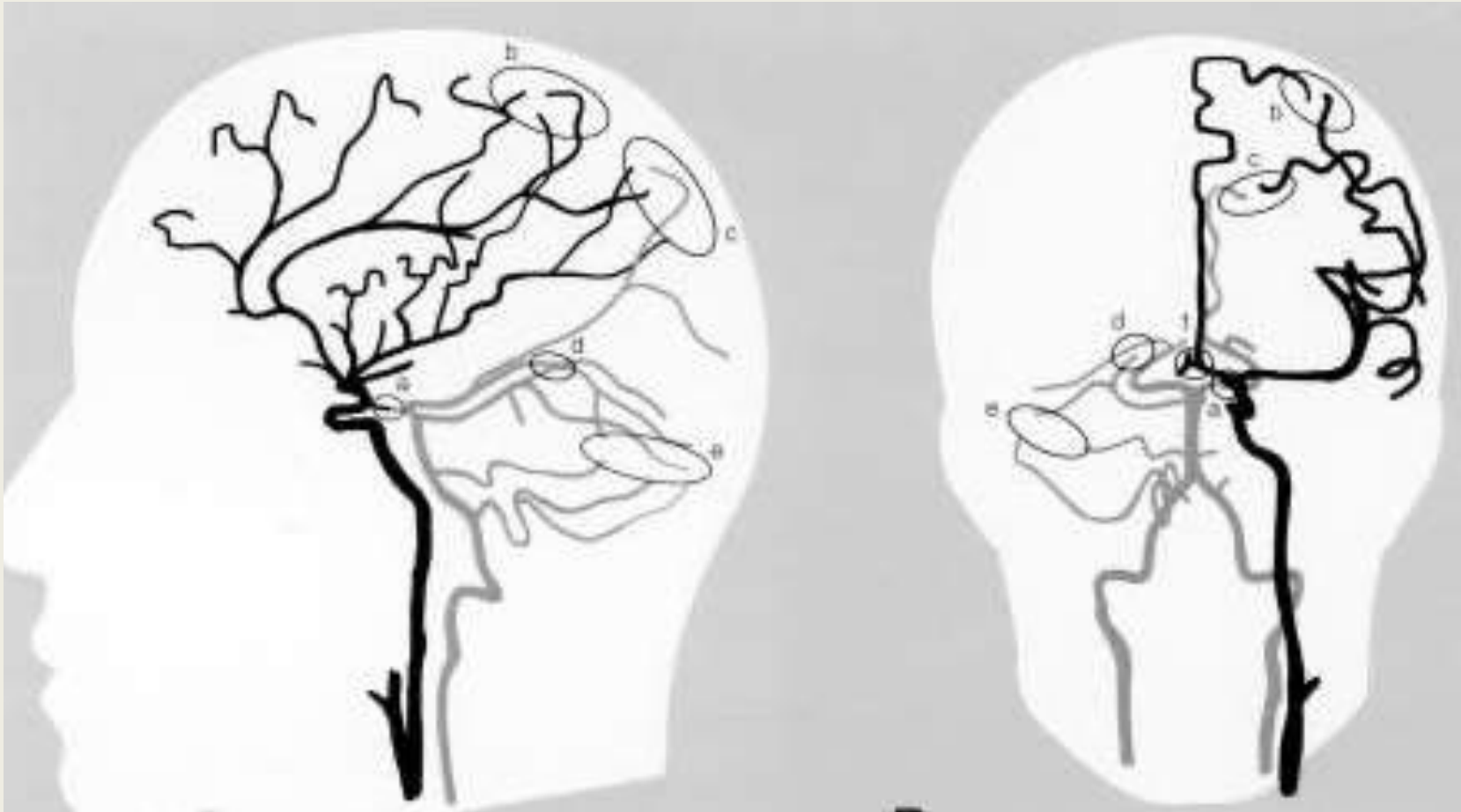
Stroke. 2003;34:2279-2284

Collateral Circulation

David S. Liebeskind, MD

İntrakranial arterial kollateral sirkülasyon

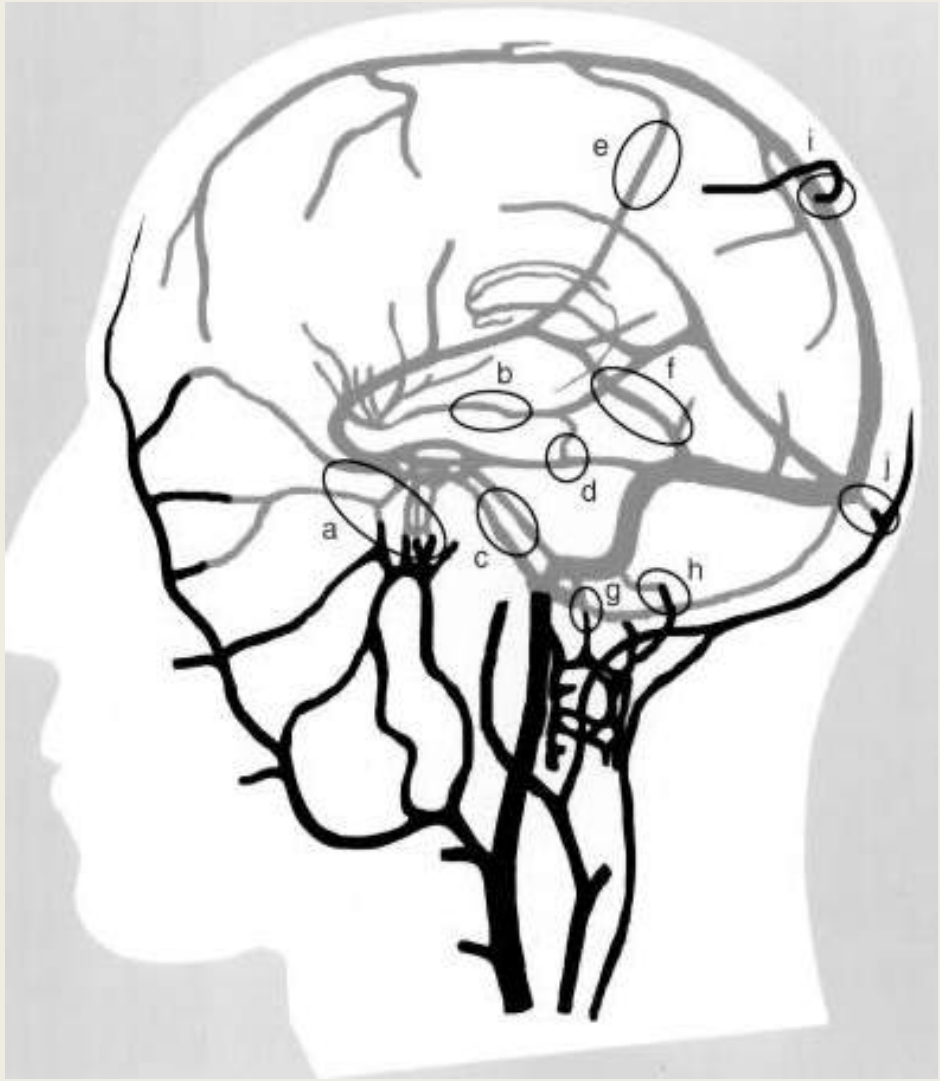
- *Pcomm (a)*
- *Leptomeningeal anastomozlar (ACA & MCA (b) MCA&PCA (c))*
- *Tektal pleksus (PCA & SCA) (d)*
- *Distal serebellar aa (e)*
- *Acomm (f)*



Stroke. 2003;34:2279-2284

Collateral Circulation

David S. Liebeskind, MD



- Venöz kollateral sirkülasyon
  - *Pterygoid pleksus (a)*
  - *Deep middle cerebral v (b)*
  - *Inferior petrosal sinus & basilar pleksus (c)*
  - *Superior petrosal sinus (d)*
  - *Anastomotic v of Trolard (e)*
  - *Anastomotic v of Labbe (f)*
  - *Condyloid emissary v (g)*
  - *Mastoid emissary v (h)*
  - *Parietal emissary v (i)*
  - *Occipital emissary v (j)*

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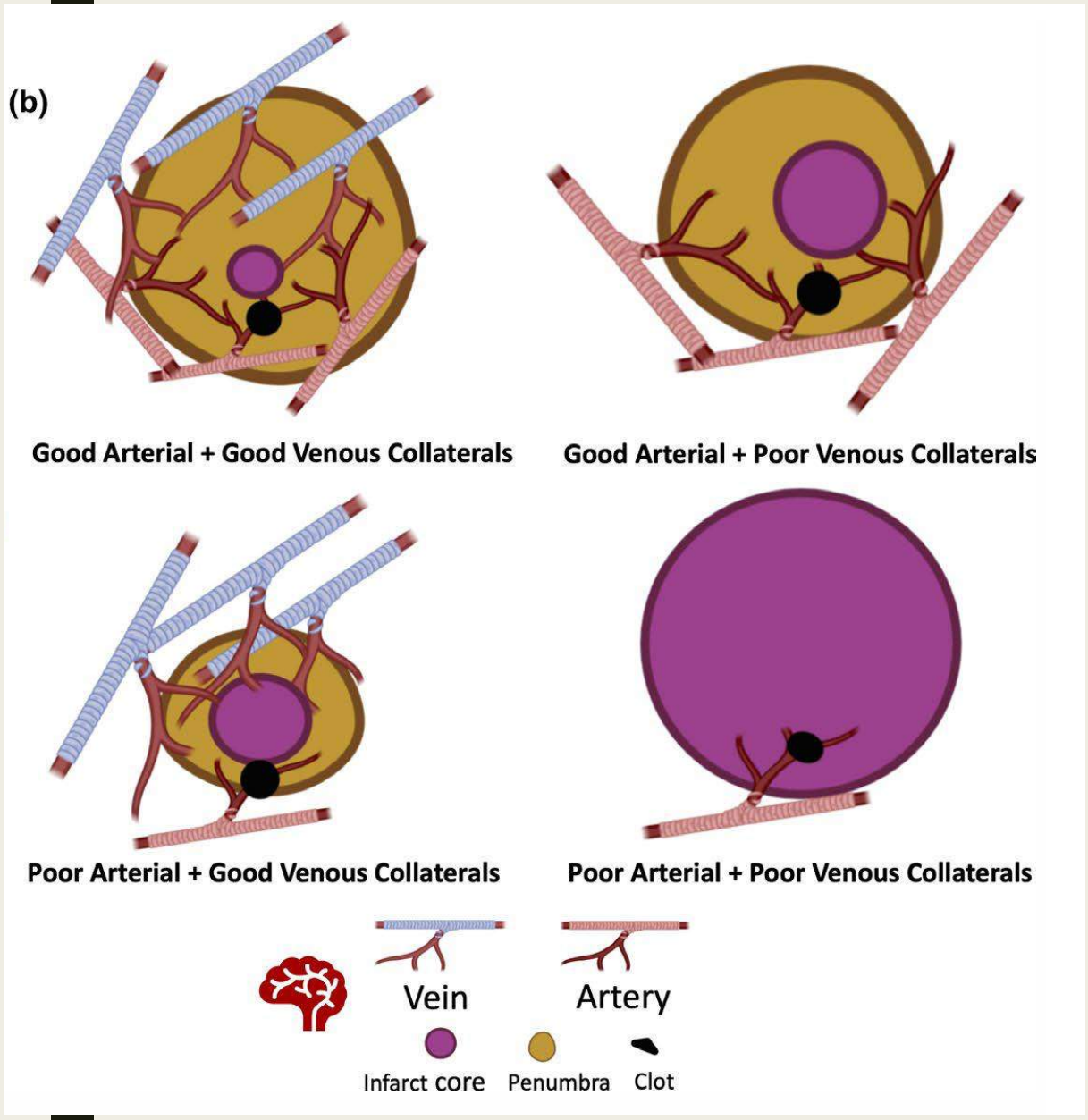
DOI: 10.1111/ejn.14955

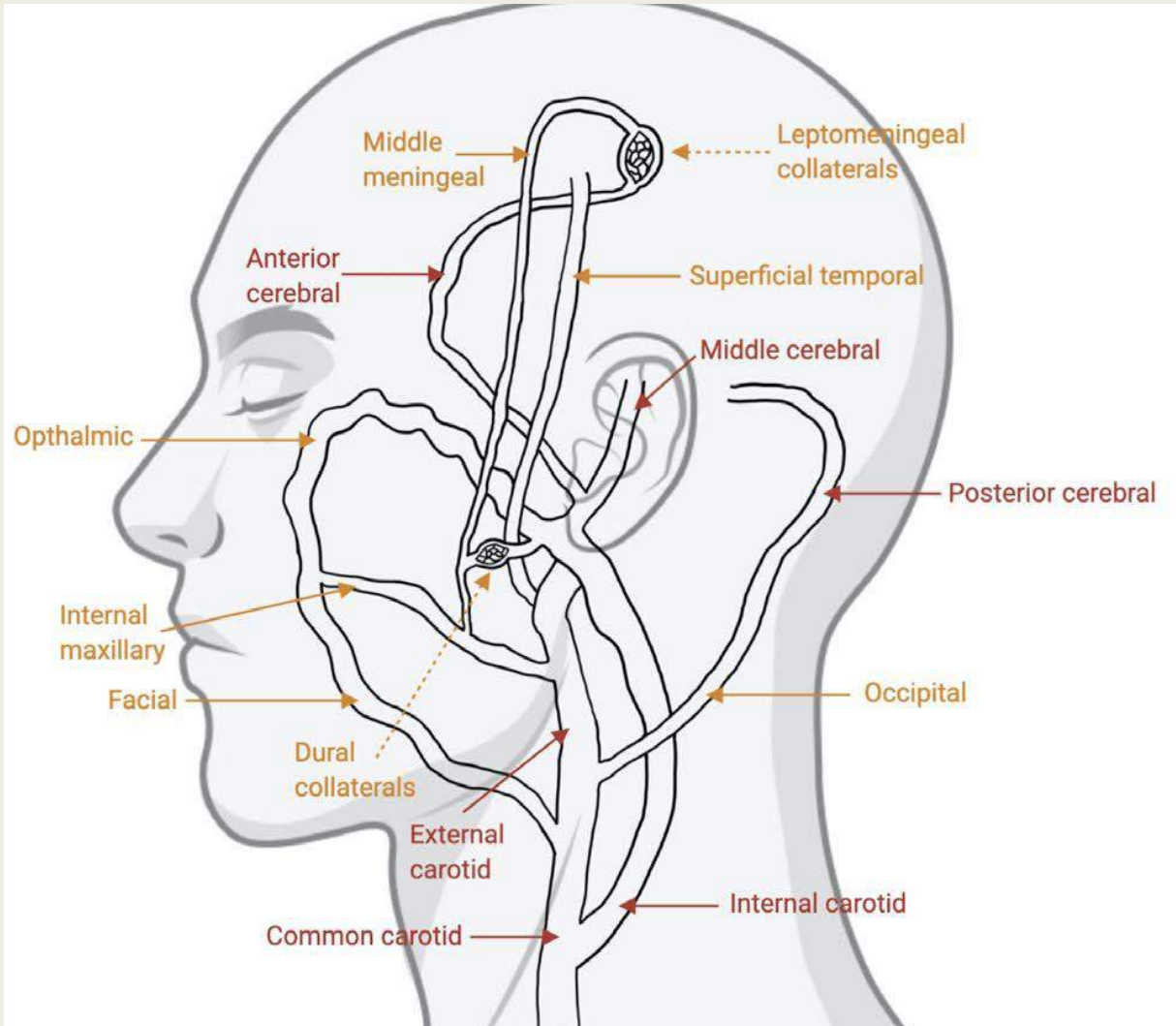
REVIEW ARTICLE

EJN European Journal of Neuroscience FENS WILEY

Cerebral collaterals in acute ischaemia: Implications for acute ischaemic stroke patients receiving reperfusion therapy

Abina Vishni Ravindran[1,3,6] | Murray C. Killingsworth[1,5,7] | Sonu Bhaskar[1,2,3,4,5,6]





Görüntüleme

- Altın standart DSA
  - *Sık bakılmaz*
  - *Kontrast hacmi ve basıncı önemli*
- TCD
  - *Transtemporal pencere*
  - *Serebral vazomotor reaktivite - otoregülasyon & kollateral durum*
    - CO_2 inhalasyonu, asetazolamid enjeksiyonu veya apne
- CTA
- MRA
  - *Willis proksimal arteriyel segmentleri*

Cerebral Collateral Circulation: A Review in the Context of Ischemic Stroke and Mechanical Thrombectomy

Guilherme Santos Piedade[1,2], Clemens M. Schirmer[1], Oded Goren[1], Hua Zhang[3], Amir Aghajanian[3], James E. Faber[3], Christoph J. Griessenauer[1,4,5]

World Neurosurgery, February 2019

Table 1. Comparison of Collateral Scoring Systems

	Digital Subtraction Angiography			CTA		
Grade	**ASITN/SIR Collateral Score**	**Christoforidis et al.[15]**	**Modified Version of ASITN/SIR Collateral Score for Dynamic CTA**	**ASPECTS-on-Collaterals***	**Tan et al.[16]**	**Miteff et al.[17]**
0	No collaterals visible to the ischemic site		Nonexistent or barely visible pial collaterals on the ischemic site during any point of time	Contrast opacification in arteries distal to the occlusion not seen	Absent collateral supply to the occluded MCA territory	
1	Slow collaterals to the periphery of the ischemic site with persistence of some of the defect	Collaterals reconstituted the distal portion of the occluded vessel segment	Partial collateralization of the ischemic site until the late venous phase	Arteries distal to the occlusion less prominent compared with a matching region in the opposite site	Collateral supply filling ≤50% but >0% of the occluded MCA territory	Contrast opacification is merely seen in the distal superficial branches
2	Rapid collaterals to the periphery of ischemic site with persistence of some of the defect and to only a portion of the ischemic territory	Collaterals reconstituted vessels in the proximal portion of the segment adjacent to the occluded vessel	Partial collateralization of the ischemic site before the venous phase	Arteries distal to the occlusion equal or more prominent compared with a matching region in the opposite site	Collateral supply filling >50% but ≤100% of the occluded MCA territory	Vessels can be seen at the Sylvian fissure
3	Collaterals with slow but complete angiographic blood flow of the ischemic bed by the late venous phase	Collaterals reconstituted vessels in the distal portion of the segment adjacent to the occluded vessel	Complete collateralization of the ischemic site by the late venous phase		Collateral supply filling 100% of the occluded MCA territory	Vessels are reconstituted distal to the occlusion
4	Complete and rapid collateral blood flow to the vascular bed in the entire ischemic territory by retrograde perfusion	Collaterals reconstituted vessels 2 segments distal to the occluded vessel	Complete collateralization of the ischemic site before the venous phase			
5		Little or no significant reconstitution of the territory of the occluded vessel				

Miteff Sistemi

- Single phase CTA
- Sylvian fissürde MCA kollateral dallarına göre 3 puanlı skorlama
  - *3p damarlar oklüzyon distaline kadar yeniden oluşmuş*
  - *2p bazı damarlar Sylvian fissürde görünüyor*
  - *1p kontrastlanma sadece distal süperfisyal damarlarda görünüyor*

Received: 29 July 2020 | Revised: 20 August 2020 | Accepted: 22 August 2020
DOI: 10.1111/ejn.14955

REVIEW ARTICLE

EJN European Journal of Neuroscience FENS WILEY

Cerebral collaterals in acute ischaemia: Implications for acute ischaemic stroke patients receiving reperfusion therapy

Abina Vishni Ravindran[1,3,6] | Murray C. Killingsworth[1,5,7] | Sonu Bhaskar[1,2,3,4,5,6]

Maas Sistemi

- Single phase CTA
- Kontralateral tarafa kıyaslama ile 5 puanlık skorlama sistemi
  - *5p taşkın*
  - *4p kontralateral taraftan daha fazla*
  - *3p kontralateral taraf ile eşit*
  - *2p kontralateral taraftan daha az*
  - *1p damar kontrastlanması yok*

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Qureshi dereceleme şeması

- Single phase CTA / MRA
- 6 puanlık bir skala
  - *5p ICA/BA oklüzyonu*
  - *4Ap/4Bp ICA/BA oklüzyonu; kollaterallerle antegrad veya retrograd akım var*
  - *3Ap/3Bp M1 kök oklüzyonu lentikülostriat damarlar korunmuş veya kayıp*
  - *2p iki dal oklüzyonu*
  - *1p bir dal oklüzyonu*
  - *0p oklüzyon yok*

Regional leptomeningeal skor

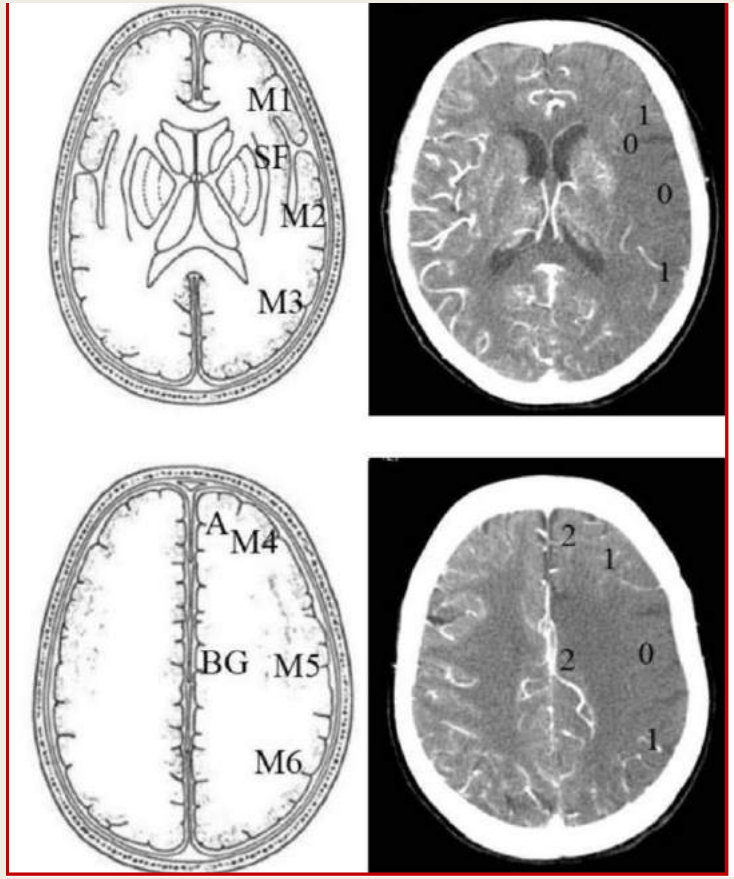
ORIGINAL ARTICLE

Assessment of Cerebral Collateral Flow With Single-Phase Computed Tomography Angiography–Based Multimodal Scales in Patients With Acute Ischemic Stroke

Haoran He, MD, Zhong-Ming Qian, MD, PhD,† Yuan Sheng, PhD,† and Yong Liu, MD, PhD**

(*J Comput Assist Tomogr* 2020;44: 708–713)

- Single phase CTA
- 20 puanlık skorlama
- ASPECT bölgelerine, ACA bölgesine ve bazal gg'a göre yapılır
  - *0 lentikülostriat/pial damar yok*
  - *1 lentikülostriat/pial damar daha az*
  - *2 lentikülostriat/pial damar kontralateral hemisfere eşit/daha belirgin*
  - *Sylvian fissürde 0-2-4 şeklinde puan verilir*



Region	Score
M1	
M2	
M3	
M4	
M5	
M6	
ACA (A)	
BasalGanglia (BG)	
Sylvian fissure (SF)	
rLMS score	

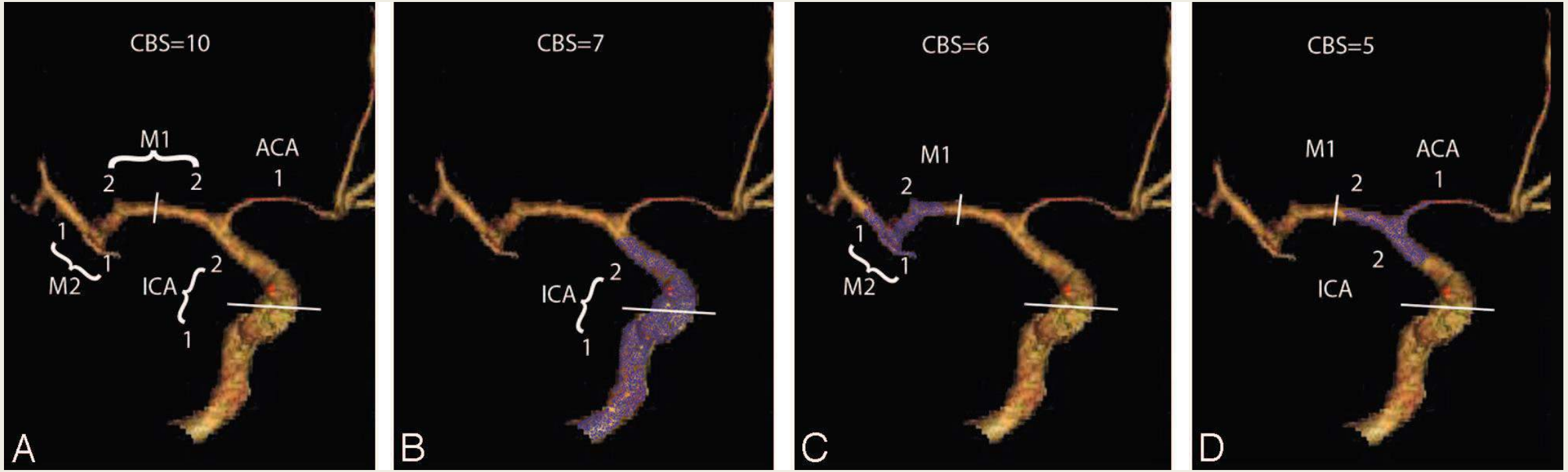
TAN skorlama

ORIGINAL RESEARCH

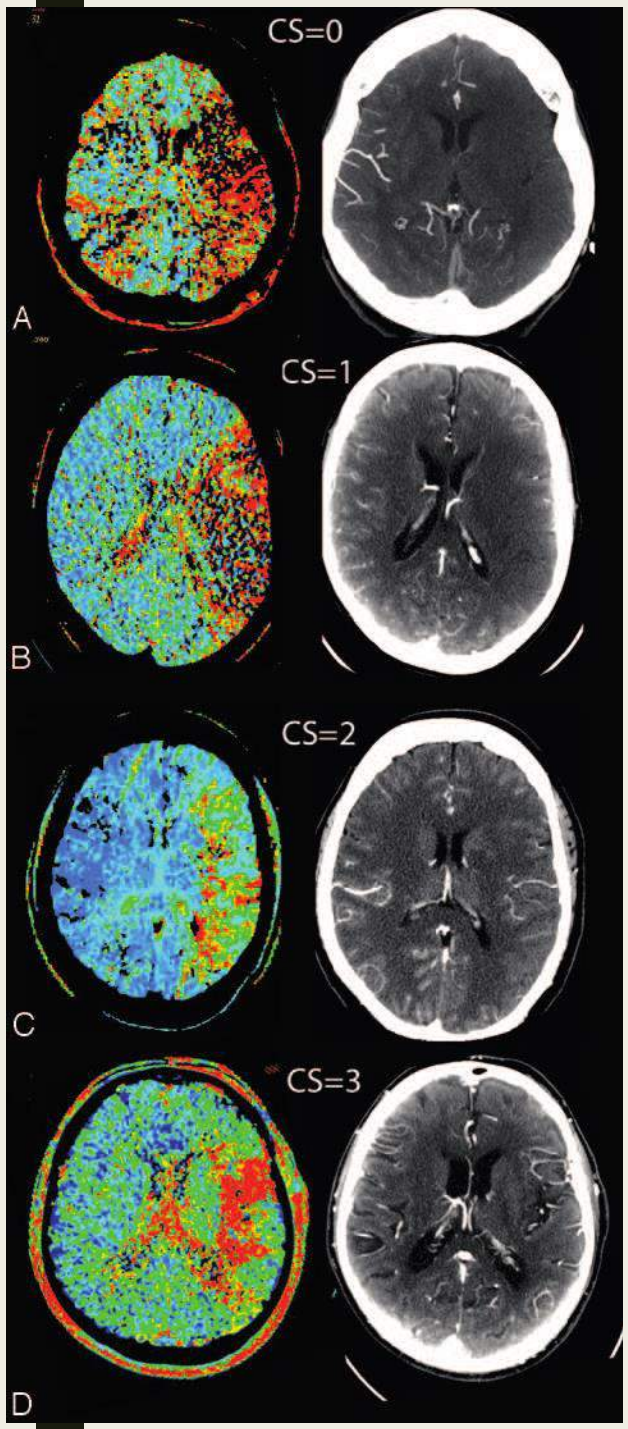
I.Y.L. Tan

CT Angiography Clot Burden Score and Collateral Score: Correlation with Clinical and Radiologic Outcomes in Acute Middle Cerebral Artery Infarct

BACKGROUND AND PURPOSE: Clot extent, location, and collateral integrity are important determinants



A 10-point score is normal, implying absence of thrombus. Two points (as indicated) are subtracted for thrombus found on CTA in the supraclinoid ICA and each of the proximal and distal halves of the MCA trunk. One point is subtracted for thrombus found in the infraclinoid ICA and A1 segment and for each affected M2 branch. *B*, Occlusion of infra- and supraclinoid ICAs with a CBS of 7. *C*, Distal M1 and 2 M2 branch occlusions produce a CBS of 6. *D*, Occlusion of the terminal ICA, proximal M1, and A1, with a resultant CBS of 5.



ORIGINAL RESEARCH

I.Y.L. Tan

CT Angiography Clot Burden Score and Collateral Score: Correlation with Clinical and Radiologic Outcomes in Acute Middle Cerebral Artery Infarct

BACKGROUND AND PURPOSE: Clot extent, location, and collateral integrity are important determinants

TAN skorlama

- 4 farklı vakanın MTT ve CTA kaynak görüntüleri, her biri sol MCA sulama alanında uzamış MTT

A. *Kollateral skor 0; Damar yok*

B. *Kollateral skor* 1; kollateral kaynak dolumu $\leq \%50$ ama $> \%0$

C. *Kollateral skor 2;* kollateral kaynak dolumu $< \%100$ ama $> \%50$

D. *Kollateral skor 3;* kollateral kaynak dolumu %100

Modifiye Tan

- Single phase CTA
- İyi ve kötü
  - *İyi*
    - Kollateraller MCA sulama alanının $\geq \%50$sinde görülüyor
  - *Kötü*
    - Kollateraller MCA sulama alanının $< \%50$sinde görülüyor

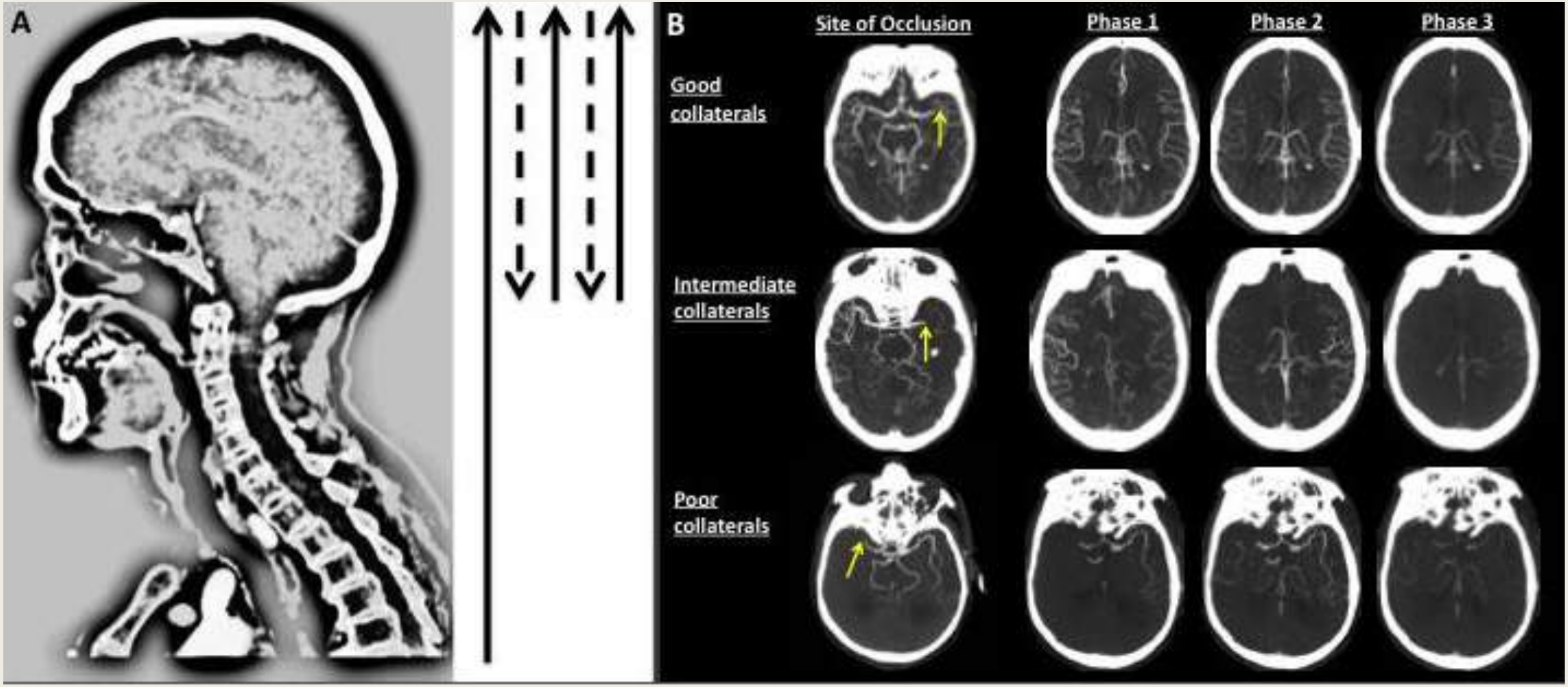
Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Goyal M, Demchuk AM, Menon BK, et al. Randomized assessment of rapid endovascular treatment of ischemic stroke. N Engl J Med 2015;372:1019-30. DOI: 10.1056/NEJMoa1414905

(PDF updated March 12, 2015.)

ESCAPE



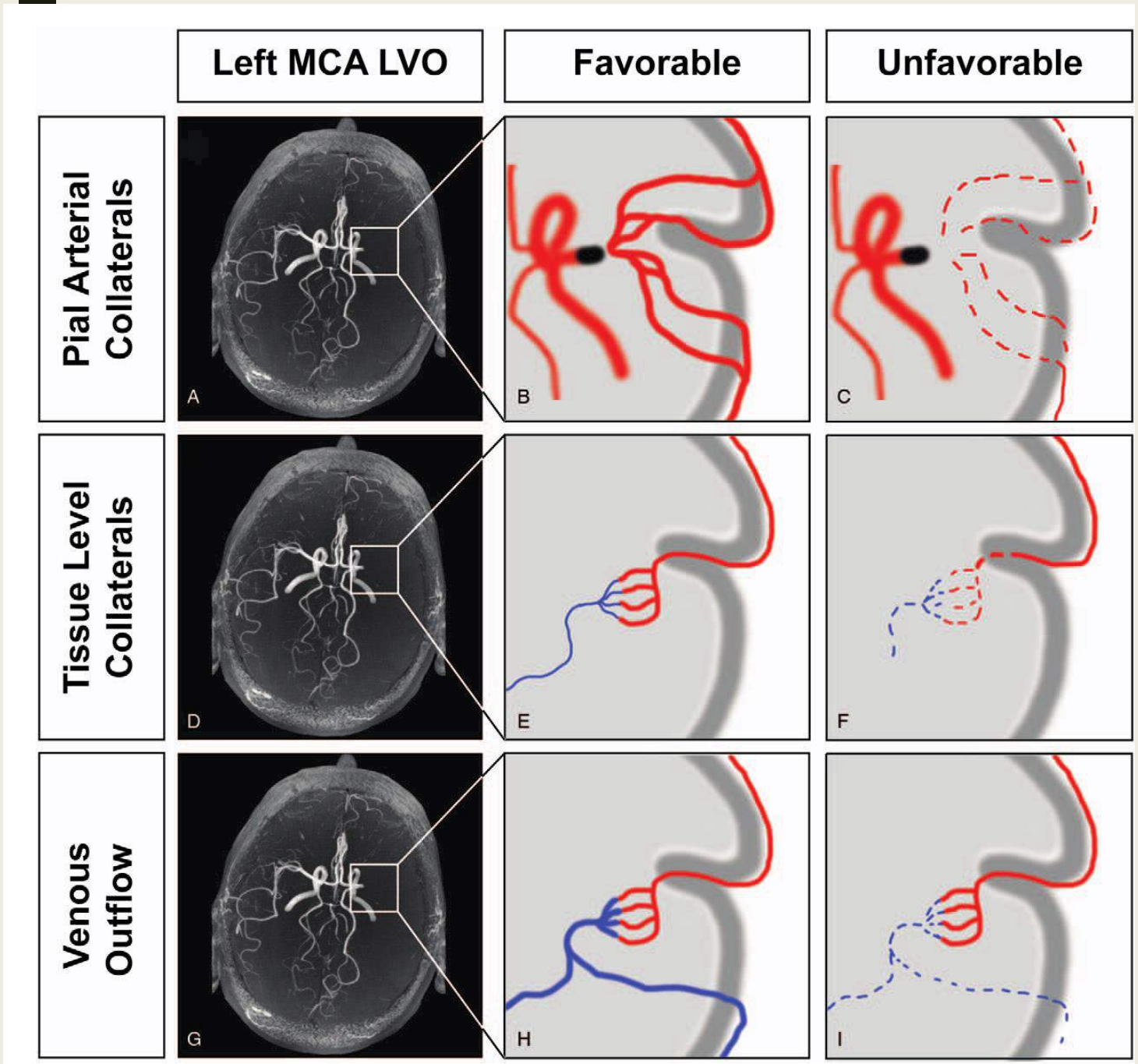
Multifaz CTA kollateral skor

Received: 29 July 2020 | Revised: 20 August 2020 | Accepted: 22 August 2020
DOI: 10.1111/ejn.14955
REVIEW ARTICLE
EJN European Journal of Neuroscience FENS WILEY

Cerebral collaterals in acute ischaemia: Implications for acute ischaemic stroke patients receiving reperfusion therapy

Abina Vishni Ravindran[1,3,6] | Murray C. Killingsworth[1,5,7] | Sonu Bhaskar[1,2,3,4,5,6]

- Multifaz CTA
- Toplam 6p
  - *5p Etkilenen hemisferde dolum gecikmesi yok*
  - *4p Etkilenen hemisferde 1 faz dolum gecikmesi var*
  - *3p Etkilenen hemisferde 2 faz dolum gecikmesi var veya 1 faz gecikme & ciddi oranda azalmış sayıda kollateraller*
  - *2p Etkilenen hemisferde 2 faz dolum gecikmesi var & ciddi oranda azalmış sayıda kollateraller veya 1 faz gecikme & damarların görünmediği alanlar var*
  - *1p Etkilenen hemisferde herhangi bir fazda birkaç damar görünüyor*
  - *0p Etkilenen hemisferde herhangi bir fazda hiç damar görünmüyor*
- ≤3p kötü prognoz ile ilişkili



REVIEW ARTICLE

Rethinking the Collateral Vasculature Assessment in Acute Ischemic Stroke

The Comprehensive Collateral Cascade

Tobias Djamsched Faizy, MD, and Jeremy Josef Heit, MD, PhD

Topics in Magnetic Resonance Imaging, August 2021

- Comprehensive collateral cascade

- COVES skorlama
- MCA sulama alanındaki ana venlerin değerlendirmesi – kortikal venöz drenaj
  - *Superficial Middle Cerebral v*
  - *Labbe v*
  - *Sfenoparietal sinüs*
- COVES ≥1 daha iyi kollateral profil & bazal ASPECT skor

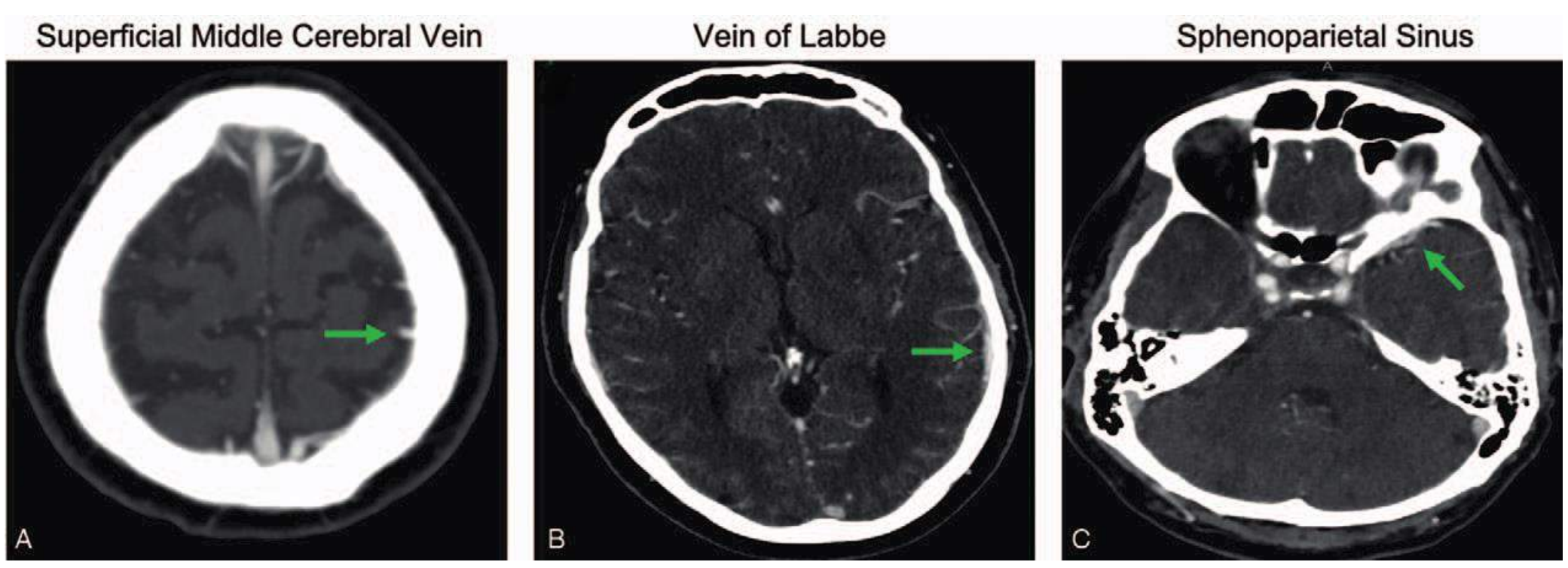
REVIEW ARTICLE

Rethinking the Collateral Vasculature Assessment in Acute Ischemic Stroke

The Comprehensive Collateral Cascade

Tobias Djamsched Faizy, MD, and Jeremy Josef Heit, MD, PhD

Topics in Magnetic Resonance Imaging, August 2021



Prognostic Evaluation based on Cortical vein score difference In Stroke score PRECISE

- Single phase CTA
- Hemisferler arası fark
  - *Superficial Middle Cerebral v*
  - *v of Labbe (VOL)*
  - *v of Trolard (VOT)*
  - *Basal v of Rosenthal (BVR)*
- *2p tam dolum*
- *1p kısmi dolum*
- *0p dolum yok*

- Kompozit Skor : etkilenmeyen hemisfer puanı – etkilenen hemisfer puanı

CRISP

Combined a**R**ter**I**al and venous grading **S**cale to **P**redict outcome in anterior circulation ischemic stroke

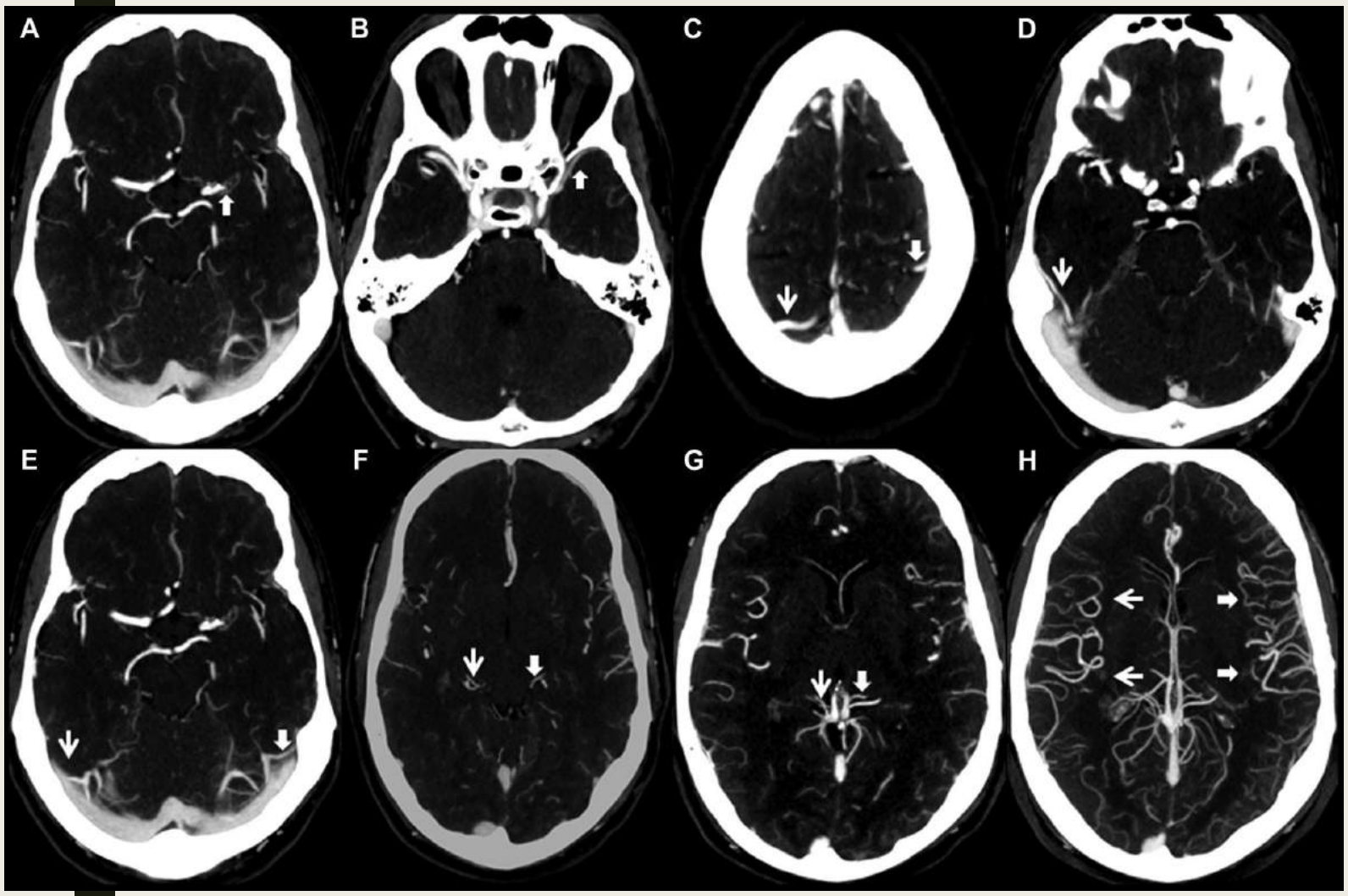
- Arterial ve PRECISE skorlamadan daha iyi 90. gün sonlanım öngörüsü
- CRISP sınıf-1 (kötü) : “kötü” venöz derece (<2 venöz dolum) ve “azalmış” kollateral derece
- CRISP sınıf-2 (ara) : “kötü” venöz derece ve “iyi” kollateral derece
- CRISP sınıf-3 (ara) : “iyi” venöz derece (≥2 venöz dolum) ve “azalmış” kollateral derece
- CRISP sınıf-4 (iyi) : “iyi” venöz derece ve “iyi” kollateral derece

A Combined Arterial and Venous Grading Scale to Predict Outcome in Anterior Circulation Ischemic Stroke

Rajsrinivas Parthasarathy, Sung-Il Sohn, Thomas Jeerakathil, Mahesh P. Kate, Sachin M. Mishra, Vivek K. Nambiar, Aftab Ahmad, Bijoy K. Menon, Ashfaq Shuaib

From the Department of Medicine, University of Alberta, Edmonton, Alberta (RP, TJ, MPK, AA, AS); Department of Neurology, Institute for Brain Research, Keimyung University School of Medicine, Daegu, South Korea (SIS); and Department of Neurosciences, Foothills Medical Centre, University of Calgary, Calgary, Alberta (SMM, VKN, BKM).

J Neuroimaging 2015



A. Sol MCA oklüzyonu

B. Sol Superficial Middle Cerebral v kısmi dolum (skor 1)

C. v of Trolard kontralat ile eşit (skor 2)

D. v of Labbe sağ hemisfer

E. v of Labbe karşı taraf ile eşit (skor 2)

F. Basal v of Rosenthal (BVR) karşı taraf ile eşit (skor 2)

G. Basal v of Rosenthal (BVR) girişi

H. Iyi kollateraller

Kompozit skor 7

CRISP sınıf 4

Clin Neuroradiol (2020) 30:789–793
https://doi.org/10.1007/s00062-019-00858-1

ORIGINAL ARTICLE

Collateral Scores in Acute Ischemic Stroke

A retrospective study assessing the suitability of collateral scores as standalone predictors of clinical outcome

Fatih Seker[1] · Benjamin Pereira-Zimmermann[2] · Johannes Pfaff[1] · Jan Purrucker[3] · Christoph Gumbinger[3] · Silvia Schönenberger[3] · Martin Bendszus[1] · Markus A. Möhlenbruch[1]

	AUC (95% CI)	Optimum cut-off	Sensitivity	Specificity	PPV	NPV
Maas	0.60 (0.51–0.70)	2.5	0.74	0.45	0.47	0.73
Miteff	0.60 (0.52–0.68)	2.5	0.86	0.32	0.46	0.78
Tan	0.61 (0.51–0.70)	2.5	0.72	0.46	0.47	0.71
ASITN/SIR	0.59 (0.49–0.70)	2.5	0.77	0.39	0.45	0.71
mCTA	0.61 (0.50–0.71)	2.5	0.88	0.26	0.44	0.77

Clin Neuroradiol (2020) 30:789–793
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ORIGINAL ARTICLE

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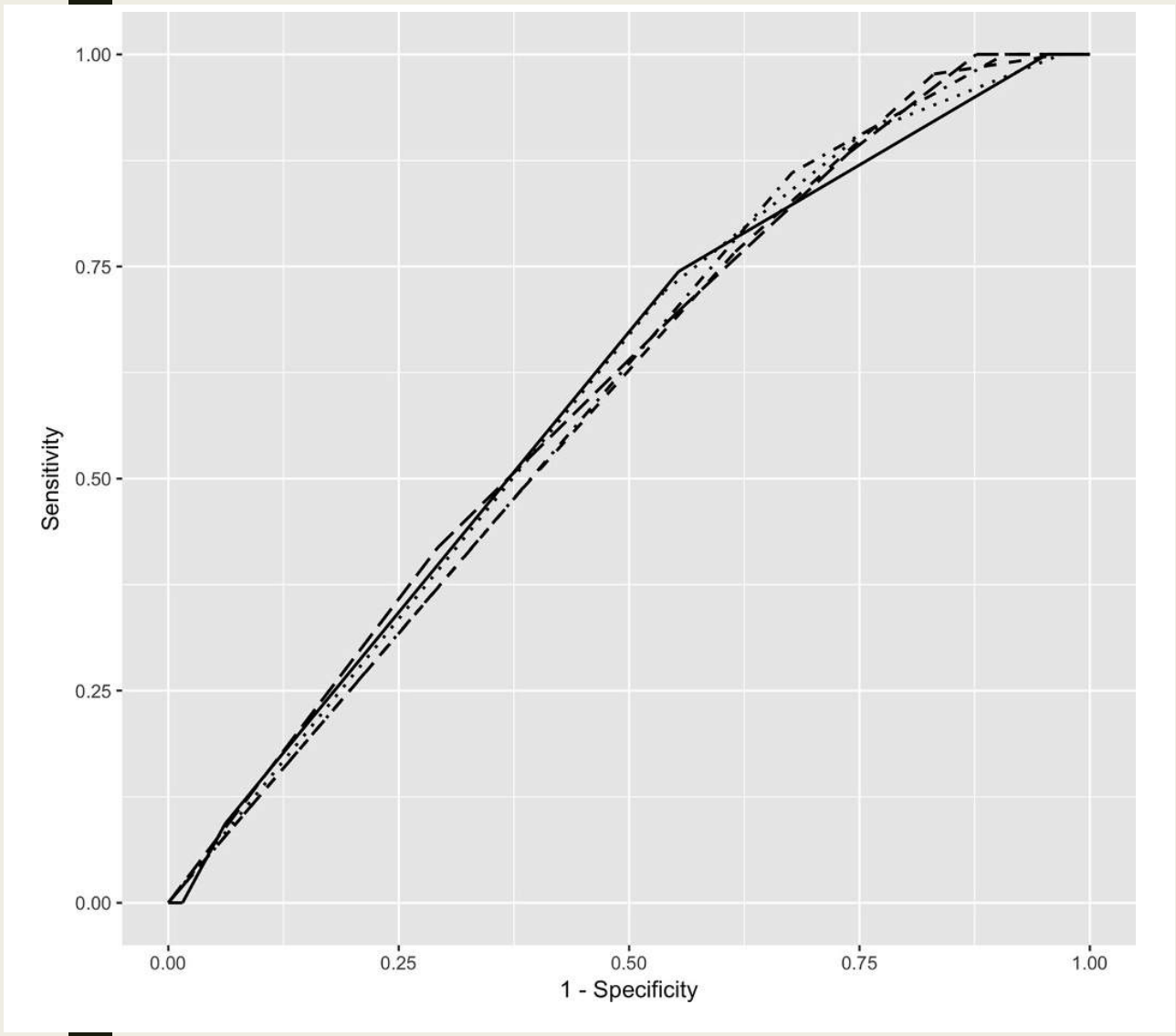


- Kollateral skorlamanın klinik sonlanım üzerinde etkisi gösterilmiş
- Analiz edilen kollateral skorlama sistemlerinin hiçbiri klinik sonlanımı tek kriter olarak yeterli öngörmemiş
- Kollateral skorlama trombektomi hasta seçiminde tek görüntüleme kriteri olarak kullanılmamalı

	All (n=43)	Fast progressors (n=15)	Other patients (n=28)	*P* value
Clinical baseline characteristics				
Age in years, median (IQR)	75.5 (62.9–84.0)	70.2 (64.7–84.0)	78.2 (61.8–84.1)	0.760
Female sex, n (%)	21 (48.8)	6 (40.0)	15 (53.6)	0.526
Medical history, n (%)				
Diabetes	14 (32.6)	5 (33.3)	9 (32.1)	1.000
Atrial fibrillation	19 (44.2)	6 (40.0)	13 (46.4)	0.755
Baseline NIHSS, median (IQR)	14 (11–19)	18 (14–20)	12 (9–17.5)	0.003
Imaging baseline characteristics				
Occlusion location on baseline CTA, n (%)				0.021
ICA-T*	9 (20.9)	7 (46.7)	2 (7.1)	
ICA-L†	2 (4.7)	1 (6.7)	1 (3.6)	
ICA-I ‡	2 (4.7)	0	2 (7.1)	
Proximal M1	7 (16.3)	3 (20.0)	4 (14.3)	
Mid M1	10 (23.3)	1 (6.7)	9 (32.1)	
Distal M1	13 (30.2)	3 (20.0)	10 (35.7)	
Ipsilateral cervical ICA occlusion, n (%)	3 (7.0)	1 (6.7)	2 (7.1)	1.000
Collateral Status, n (%)				0.021
Poor	3 (7.1)	3 (20.0)	0	
Intermediate	2 (4.8)	1 (6.7)	1 (3.7)	
Good	37 (88.1)	11 (73.3)	26 (96.3)	
Treatment and time				
Intravenous alteplase, n (%)	33 (76.7)	14 (93.3)	19 (67.9)	0.127
Onset-to-imaging time, min, median (IQR)	101 (66–156)	75 (59–115)	101.5 (74.5–190.5)	0.090
Imaging-to-repeat CTA time, min, median (IQR)	312 (239–360), n=41	312 (252–347)	297 (219–378), n=26	0.705
Clinical and imaging outcomes				
24-h NIHSS, median (IQR)	13.5 (9–18), n=42	18 (14–24)	10 (6–15), n=27	0.001
mRS score 0–2 at 90 d, n (%)	11 (25.6)	2 (13.3)	9 (32.1)	0.276
24-h ASPECTS, median (IQR)	8 (4–9)	4 (0–5)	8 (7–9)	<0.001
24-h infarct, mL, median (IQR)	33 (12–105)	146 (58–258)	16 (7–46.5)	<0.001
24-h parenchymal hemorrhage, n (%)	7 (16.3)	2 (13.3)	5 (17.9)	1.000

Stroke

May 2021

BRIEF REPORT

Which Acute Ischemic Stroke Patients Are Fast Progressors?

Results From the ESCAPE Trial Control Arm

Johanna M. Ospel, MD; Michael D. Hill, MD; Manon Kappelhof, MD; Andrew M. Demchuk, MD; Bijoy K. Menon, MD; Arnuv Mayank; Dar Dowlatshahi, MD; Don Frei, MD; Jeremy L. Rempel, MD; Blaise Baxter, MD; Mayank Goyal, MD, PhD

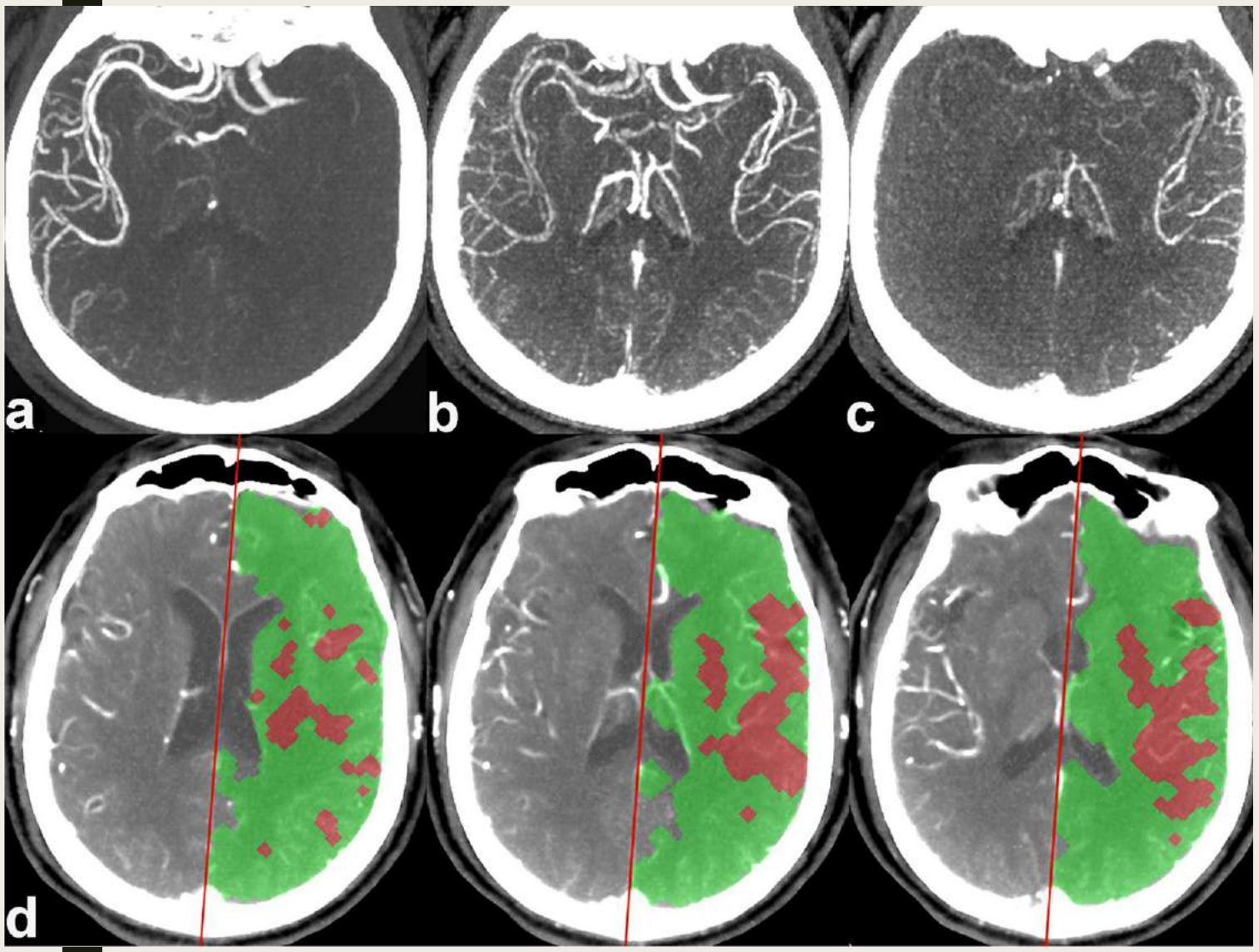
- Karotid Terminal oklüzyon
- Kollateral akım
  - *ACA&PCA'dan*

European Radiology (2019) 29:4922–4929
https://doi.org/10.1007/s00330-019-06027-9

NEURO

Comparison of CT angiography collaterals for predicting target perfusion profile and clinical outcome in patients with acute ischemic stroke

Shan-shan Lu[1] · Xuan Zhang[1] · Xiao-quan Xu[1] · Yue-zhou Cao[2] · Lin bo Zhao[2] · Qiang-hui Liu[3] · Fei-yun Wu[1] · Sheng Liu[2] · Hai-bin Shi[2]



- a. sCTA kötü kollateraller (derece 1)
- a-c mCTA iyi kollateraller (derece 4)
- CTP mismatch oranı 7.19

European Radiology (2019) 29:4922–4929
https://doi.org/10.1007/s00330-019-06027-9

NEURO

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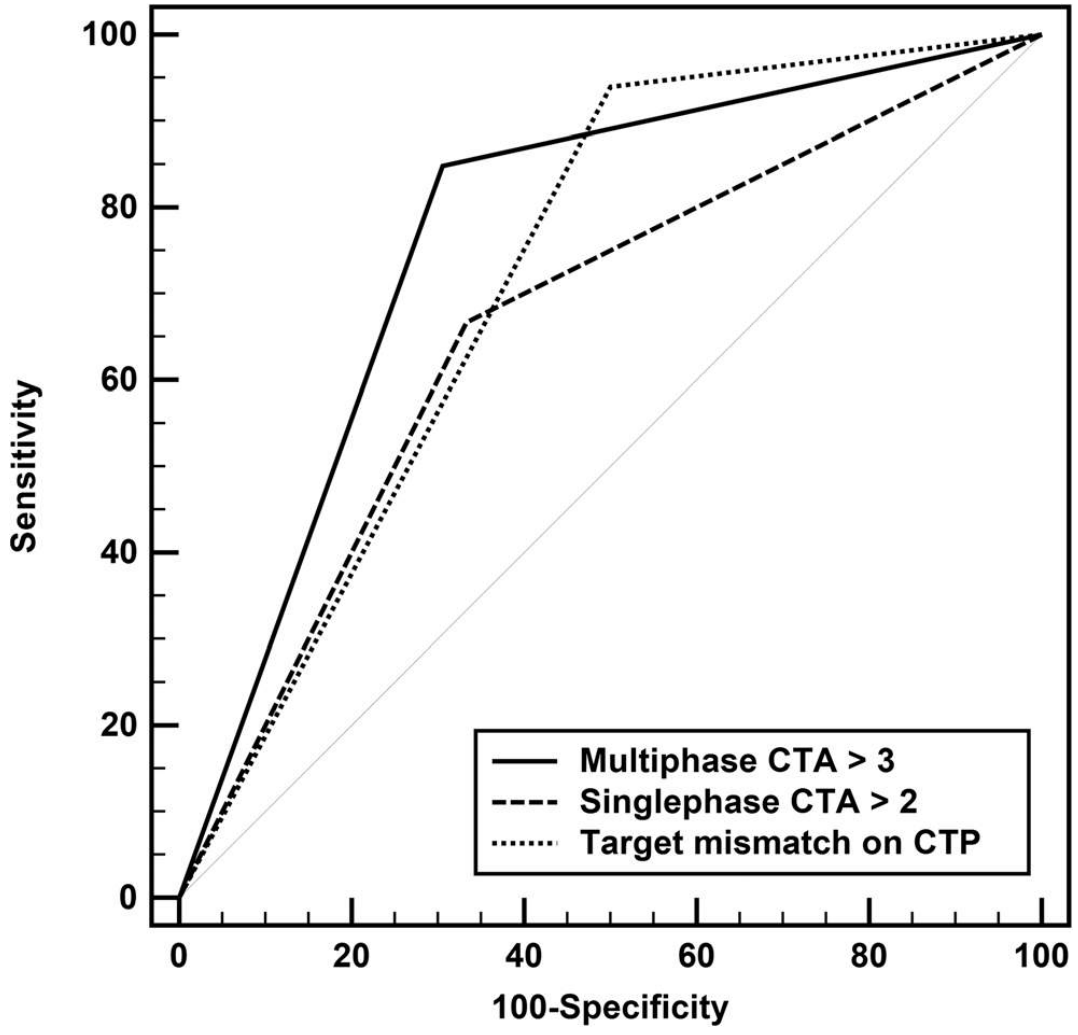


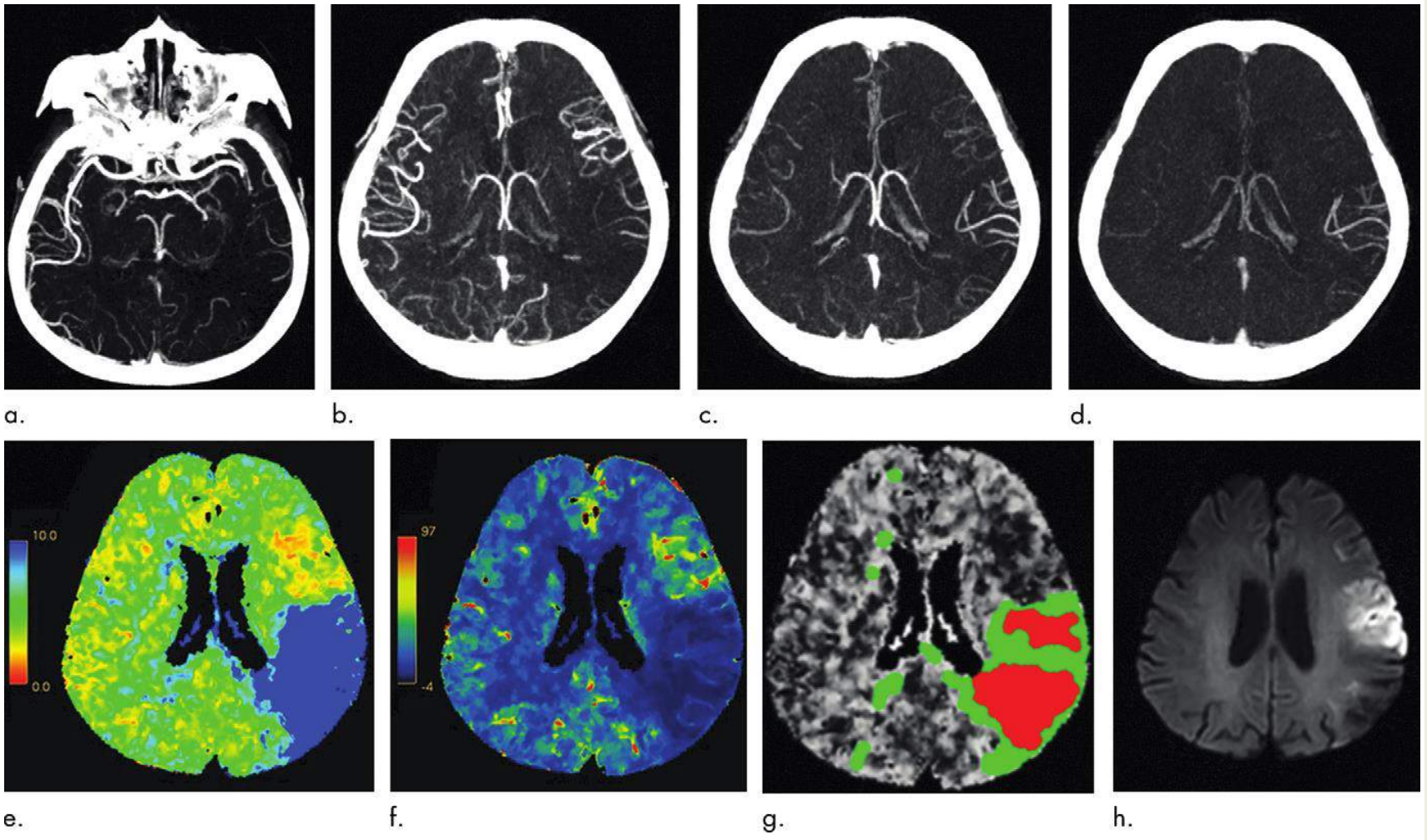
- AİS 5-15 saat ve semptom zamanı bilinmeyen
  - *Daha iyi kollateraller daha küçük iskemik kor hacmi ve daha büyük mismatch oranı ile ilişkili*
- sCTA pial arteriel dolumu mCTA'dan daha az öngörmüş
- mCTA > sCTA
  - *CTP'da hedef mismatch belirleme*
  - *90. gün mRS 0-2 öngörme*
- mCTA eşik değer 3

mRS 0-2

Radiology
ORIGINAL RESEARCH · NEURORADIOLOGY

Collateral Status at Single-Phase and Multiphase CT Angiography versus CT Perfusion for Outcome Prediction in Anterior Circulation Acute Ischemic Stroke

2020; 296:393–400



a. M2 oklüzyonu

b. Single phase CTA (tepe arterial faz); parietal lobda azalmış pial damarlar

b-d Multi phase CTA; perifer damarların dolumunda 1 faz gecikme.

Geç fazda kollateral damarların tam olmayan boşalımı

e-f time to max ve CBF haritaları

g. iskemik kor (kırmızı) hipoperfüze alan (yeşil)

h. iv tromboliz sonrası final enfarkt alanı

Radiology
ORIGINAL RESEARCH · NEURORADIOLOGY

Collateral Status at Single-Phase and Multiphase CT Angiography versus CT Perfusion for Outcome Prediction in Anterior Circulation Acute Ischemic Stroke

2020; 296:393–400

Table 4: Criterion Values and Coordinates of the Receiver Operating Characteristic Analysis Regarding a Favorable Clinical Outcome

Variable	AUC	95% CI	Youden Index	Associated Criterion	Sensitivity (%)	95% CI (%)	Specificity (%)	95% CI (%)
Single-phase Menon score	0.64	0.54, 0.72	0.22	>2	70.2	56.6, 81.6	51.6	38.6, 64.5
Multiphase Menon score	0.72	0.63, 0.80	0.36	>3	68.4	54.8, 80.1	67.7	54.7, 79.1
Hypoperfusion volume	0.72	0.63, 0.80	0.37	<150.2 mL	80.7	68.1, 90.0	56.5	43.3, 69.0
Ischemic core volume	0.71	0.62, 0.79	0.38	<8.4 mL	71.9	58.5, 83.0	66.1	53.0, 77.7

Note.—AUC = area under the curve, CI = confidence interval.

Radiology
ORIGINAL RESEARCH · NEURORADIOLOGY

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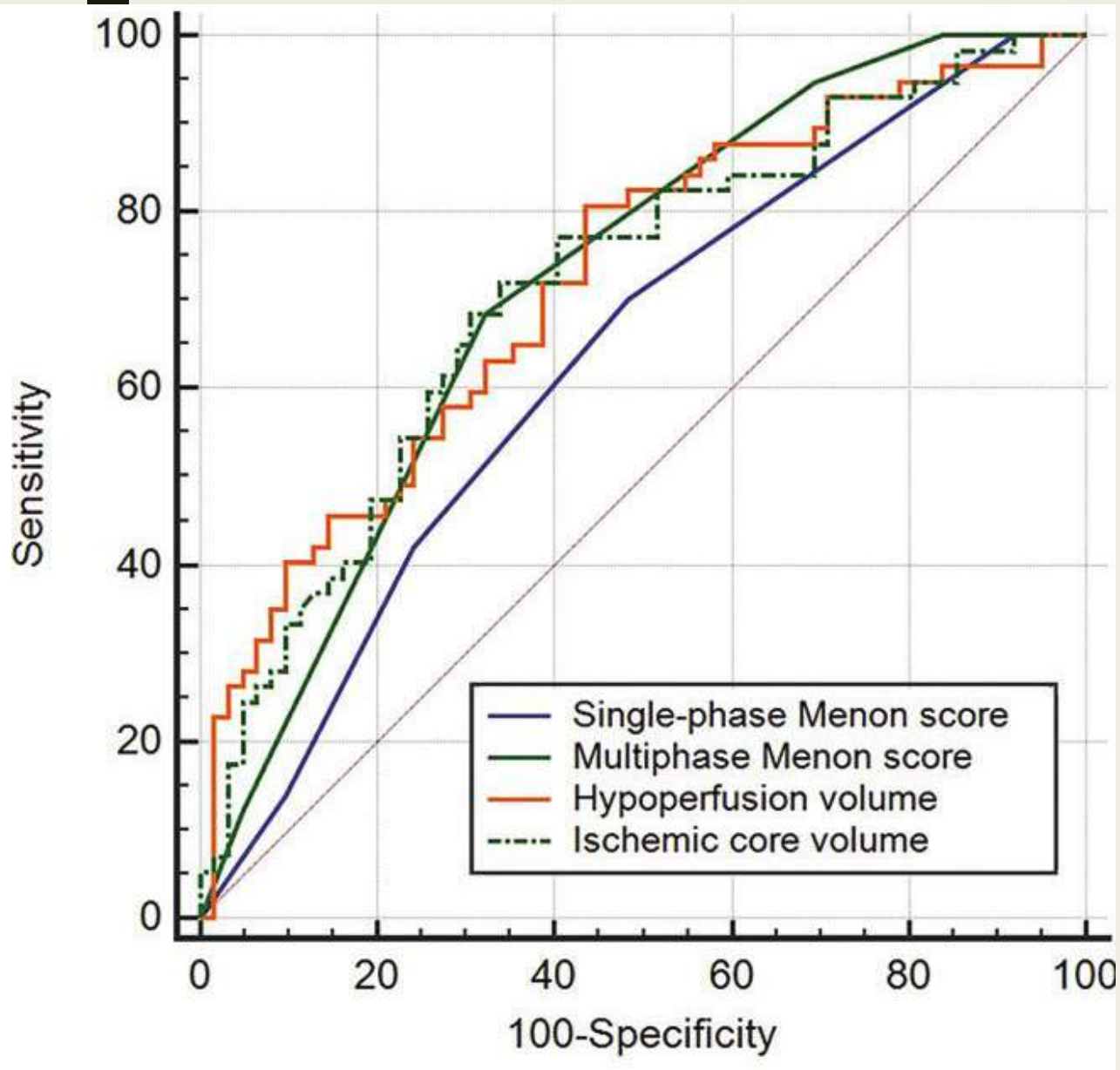


- Single & multi faz CTA kollateral skorları ile final infarkt hacmi arasında orta derecede negatif korelasyon
  - *Pıhtı uzunluğu >8mm*
  - *Erken reperfüzyon olmayanlarda*
- 90. gün iyi klinik sonlanımı öngörmede
  - *mCTA>sCTA*
  - *mCTA ≈ CTP*

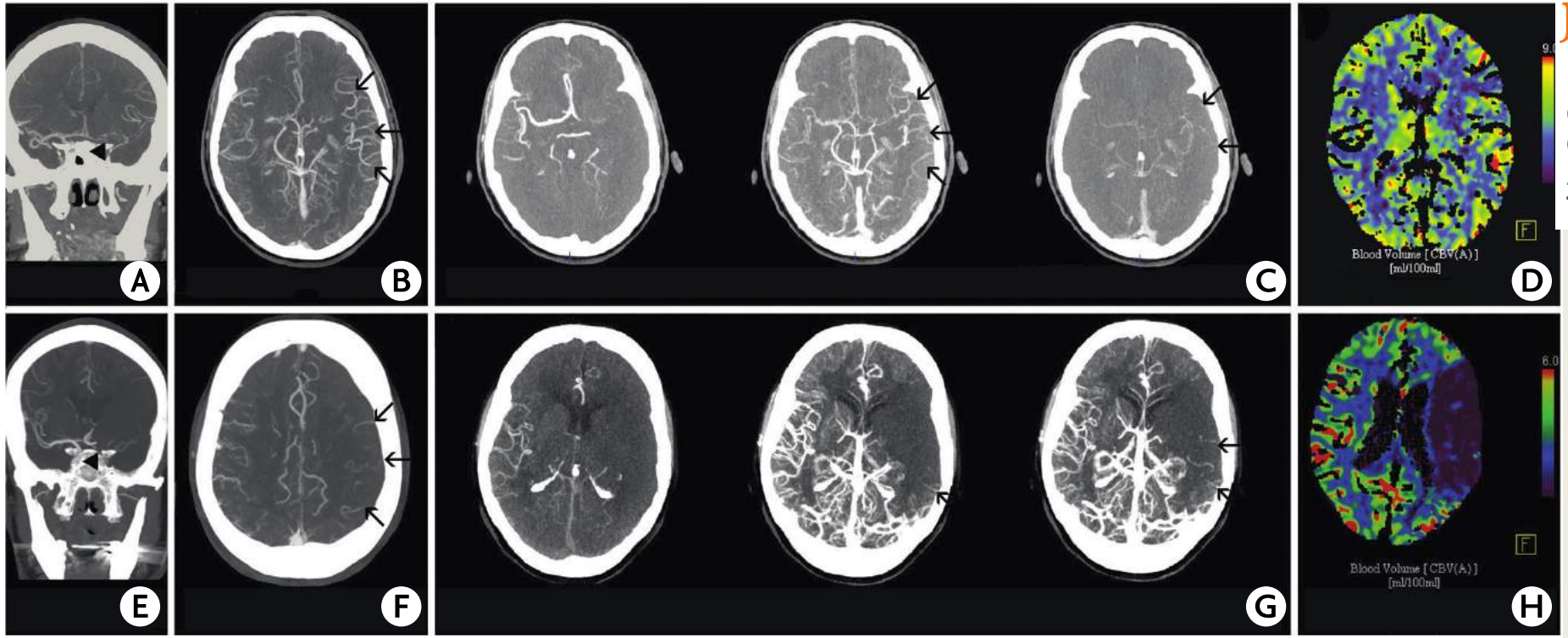
JoS JOURNAL OF STROKE

Journal of Stroke 2018;20(3):362-372
https://doi.org/10.5853/jos.2018.00605

Original Article

Outcome Prediction Using Perfusion Parameters and Collateral Scores of Multi-Phase and Single-Phase CT Angiography in Acute Stroke: Need for One, Two, Three, or Thirty Scans?

Score	sp Menon score [14]	mp Menon score [13]	mod mp Menon score [23]			LMC score [9]
Description	Beyond the occluded artery within the symptomatic and compared with the asymptomatic contralateral hemisphere, there is/are:					When compared to a matching region in the contralateral hemisphere, there is/are:
Region				ACA-MCA-region	MCA-PCA-region	ASPECTS region M1-6, Sylvian sulcus, ACA, basal ganglia
	Normal/increased prominence and extent of pial vessels	No delay and normal/increased prominence and extent of pial vessels	No delay and normal/increased prominence and extent of pial vessels	Excellent (5)	Excellent (5)	Equal/more prominent lenticulostriate/pial vessels (2)
	Slightly reduced prominence and extent of pial vessels	One-phase delay in filling in of peripheral vessels, but prominence and extent is the same	Delay in filling in of peripheral vessels, but prominence and extent is the same	Good (4)	Good (4)	Less prominent lenticulostriate/pial vessels (1)
	Moderately reduced prominence and extent of pial vessels	Two-phase delay in filling in of peripheral vessels or one-phase delay and significantly reduced number of vessels	Delay in filling in of peripheral vessels and significantly reduced number of vessels	Fair (3)	Fair (3)	No lenticulostriate/pial vessels (0)
	Decreased prominence and extent of pial vessels	Two-phase delay in filling in of peripheral vessels and decreased prominence and extent or one-phase delay and some ischemic regions with no vessels	Delay in filling in of peripheral vessels and decreased prominence and extent as well as some ischemic regions with no vessels	Poor (2)	Poor (2)	
	Just a few vessels visible	Just a few vessels visible in any phase	Just a few vessels visible	Minimal (1)	Minimal (1)	
	No vessels visible	No vessels visible in any phase	No vessels visible	None (0)	None (0)	
Maximum score	10	10	10			20
Used for scoring of	tMIP, spCTA	3p-mpCTA	2p-mpCTA			spCTA



JoS JOURNAL OF STROKE
Journal of Stroke 2018;20(3):362-372
https://doi.org/10.5853/jos.2018.00805
Original Article

Outcome Prediction Using Perfusion Parameters and Collateral Scores of Multi-Phase and Single-Phase CT Angiography in Acute Stroke: Need for One, Two, Three, or Thirty Scans?

- Sol terminal karotid a. oklüzyonu olan iki hasta; iyi kollateraller (A-D) ve kötü kollateraller (E-H)
- Single faz kollateral akım değerlendirme (B,F) (sp Menon skor)
  - *hasta A skor 10, hasta B skor 2*
- Multi faz kollateral akım değerlendirme (C,G)
  - *ilk görüntüler Tepe arteriyal faz*
  - *7.5 saniyelik zamansal rezolüsyon ile takip eden fazlar*
  - *Hasta A; 1 faz gecikme ancak yayılım ve belirginlik benzer; mp Menon skor 8*
  - *Hasta B; 1 faz gecikme ve damarların görünmediği bazı iskemik bölgeler; mp Menon skor 2*
- CBV haritaları (D&H)
  - *Hasta A CBV-ASPECT skor 7; Hasta B CBV-ASPECT skor 0*

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Journal of Stroke 2018;20(3):362-372
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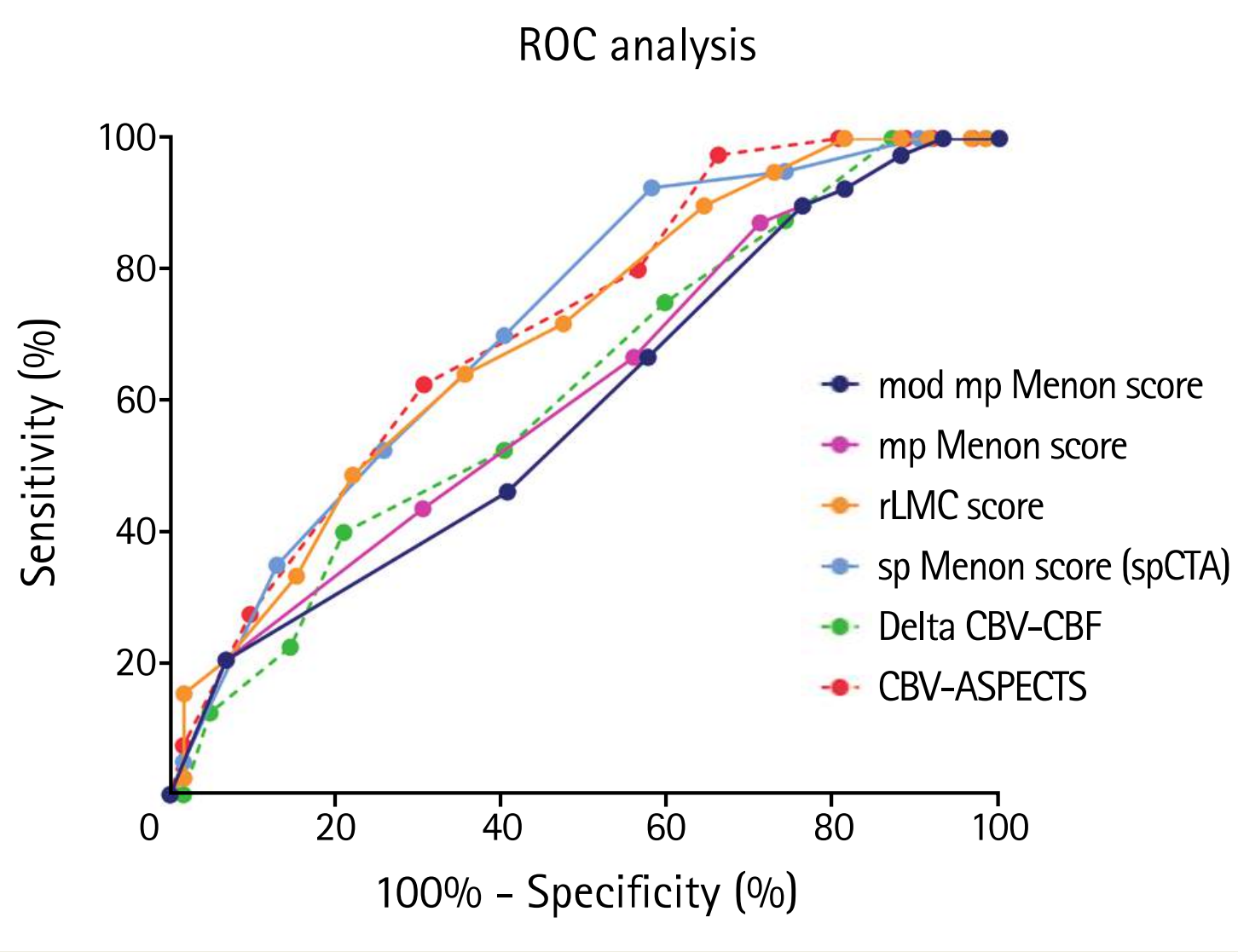
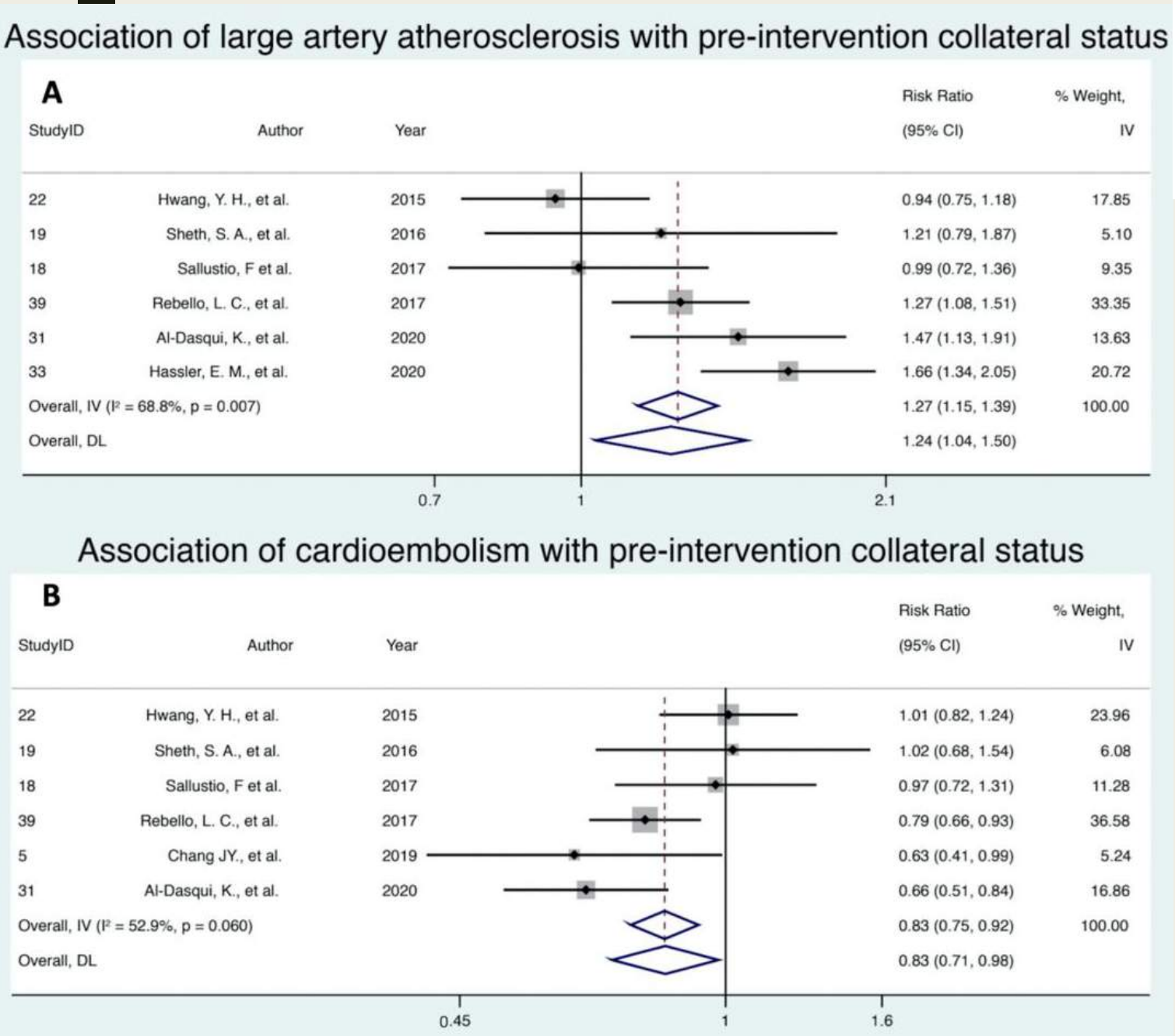


- iyi klinik sonlanım 90.gün mRS ≤2
- mpCTA klinik sonlanım öngörüsü spCTA'dan daha iyi bulunmamış
- Trombektomi için NCCT ve spCTA'dan fazlasına ihtiyaç yok



neurology international

MDPI

Article

Published: 16 November 2021

Stroke Aetiology and Collateral Status in Acute Ischemic Stroke Patients Receiving Reperfusion Therapy—A Meta-Analysis

Akansha Sinha [1,2], Peter Stanwell [3], Roy G. Beran [1,2,4,5,6,7], Zeljka Calic [1,2,5], Murray C. Killingsworth [1,2,4,8] and Sonu M. M. Bhaskar [1,4,5,*]

- Büyük arter aterosklerozu işlem öncesi daha iyi kollaterallerle
- Kardiyoemboli işlem öncesi daha kötü kollaterallerle
  - *İlişkili bulunmuş*

MR CLEAN

- TAN skorlama
- Kötü kollateraller &
  - *Daha ileri yaş*
  - *Erkek*
  - *Yüksek başvuru kan şekeri*
  - *ICA-T oklüzyonu*

***Stroke*. 2020;51:1493-1502**

Clinical and Imaging Determinants of Collateral Status in Patients With Acute Ischemic Stroke in MR CLEAN Trial and Registry

Eveline J.A. Wiegers, BSc; Maxim J.H.L. Mulder, MD, PhD; Ivo G.H. Jansen, MD, PhD; Esmee Venema, MD; Kars C.J. Compagne, BSc; Olvert A. Berkhemer, MD, PhD; Bart J. Emmer, MD, PhD; Henk A. Marquering, PhD; Adriaan C.G.M. van Es, MD, PhD; Marieke E. Sprengers, MD, PhD; Wim H. van Zwam, MD, PhD; Robert J. van Oostenbrugge, MD, PhD; Yvo B.W.E.M. Roos, MD, PhD; Charles B.L.M. Majoie, MD, PhD; Bob Roozenbeek, MD, PhD; Hester F. Lingsma, PhD; Diederik W.J. Dippel, MD, PhD; Aad van der Lugt, MD, PhD; on behalf of the MR CLEAN Trial and MR CLEAN Registry Investigators*

	Total (n=1988)	Grade 0 (n=123)	Grade 1 (n=596)	Grade 2 (n=734)	Grade 3 (n=422)	*P* Value
Clinical						
Age, y; median (IQR)	69 (58–79)	72 (60–79)	71 (61–80)	68 (58–78)	67 (56–77)	<0.001
Men, no. (%)	1086 (55)	81 (66)	355 (60)	392 (53)	199 (47)	<0.001
NIHSS; median (IQR)	16 (12–20)	19 (15–23)	18 (14–22)	16 (12–19)	14 (10–18)	<0.001
SBP, mm Hg; mean (SD)	149 (25)	154 (25)	149 (25)	148 (25)	148 (24)	0.04
DBP, mm Hg; mean (SD)	82 (15)	85 (15)	82 (16)	81 (15)	81 (16)	0.01
Glucose at baseline, mmol/L; median (IQR)	6.7 (5.9–8.0)	7.1 (6.0–8.5)	6.8 (6.0– 8.1)	6.7 (5.8– 7.9)	6.5 (5.8–7.8)	0.01
Atrial fibrillation, n (%)	462 (24)	34 (28)	134 (23)	180 (25)	87 (21)	0.24
Hypercholesterolemia, n (%)	560 (29)	35 (29)	185 (32)	192 (27)	111 (27)	0.19
Hypertension, n (%)	973 (49)	59 (48)	315 (53)	334 (46)	199 (48)	0.06
Diabetes mellitus, n (%)	323 (16)	26 (21)	91 (15)	120 (16)	61 (15)	0.33
Myocardial infarction, n (%)	302 (15)	19 (16)	100 (17)	107 (15)	54 (13)	0.34
Peripheral artery disease, n (%)	159 (8.1)	8 (6.6)	66 (11)	58 (8.0)	22 (5.3)	0.01
Ischemic stroke, n (%)	304 (15)	21 (17)	108 (18)	104 (14)	54 (13)	0.08
Prestroke modified Rankin Scale score, n (%)						0.10
0	1395 (71)	81 (68)	409 (69)	524 (72)	302 (73)	
1	240 (12)	19 (16)	64 (11)	90 (12)	51 (12)	
2	135 (6.9)	10 (8)	47 (8)	46 (6)	24 (6)	
>2	190 (10)	10 (8)	69 (12)	65 (9)	39 (9)	
Current smoking, n (%)	481 (29)	27 (22)	146 (25)	180 (25)	113 (27)	0.50
Statin use, n (%)	666 (34)	44 (36)	232 (40)	221 (30)	128 (31)	<0.01
Antiplatelet use, n (%)	638 (32)	37 (30)	235 (40)	209 (29)	121 (29)	<0.001
Antihypertensive medication use, n (%)	1004 (51)	59 (50)	338 (57)	353 (49)	194 (47)	<0.01
Intravenous alteplase treatment, n (%)	1607 (81)	95 (77)	485 (81)	598 (81)	338 (80)	0.52
Imaging						
Level of occlusion on noninvasive vessel imaging, n (%)						<0.001
ICA	86 (4.5)	2 (1.6)	21 (3.5)	31 (4.3)	27 (6.4)	
ICA-T	447 (23)	46 (37)	176 (30)	157 (22)	64 (15)	
M1	1144 (60)	63 (51)	333 (56)	452 (61)	271 (64)	
M2	214 (11)	12 (10)	60 (10)	88 (12)	52 (12)	
ASPECTS on NCCT—median (IQR)	9 (7–10)	8 (6–10)	8 (7–10)	9 (7–10)	9 (8–10)	<0.001
Other						
Time from onset to CTA—median (IQR)	105 (72–171)	106 (66–183)	99 (72–160)	104 (72–174)	115 (80–189)	0.23

Stroke. 2020;51:1493-1502

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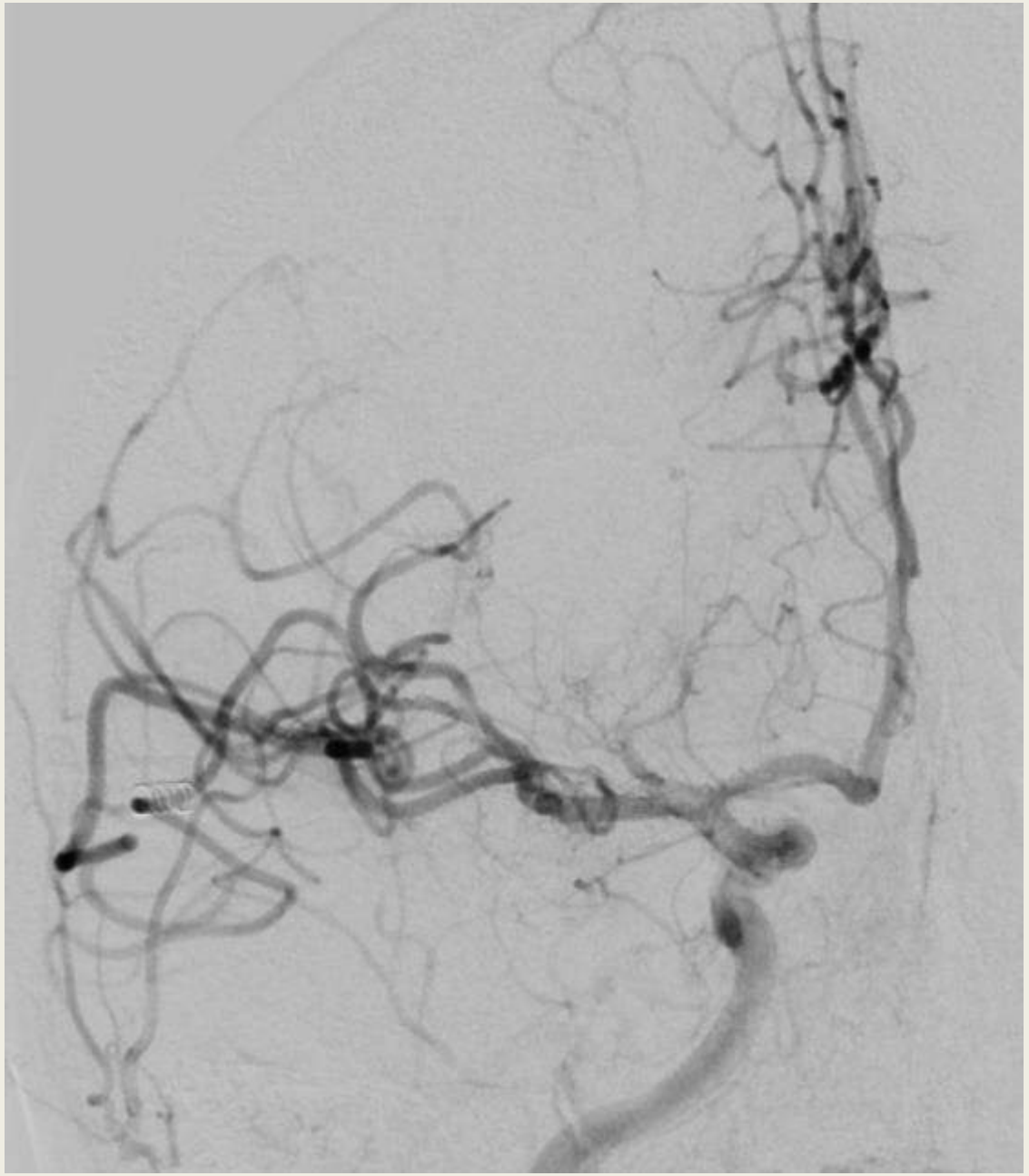

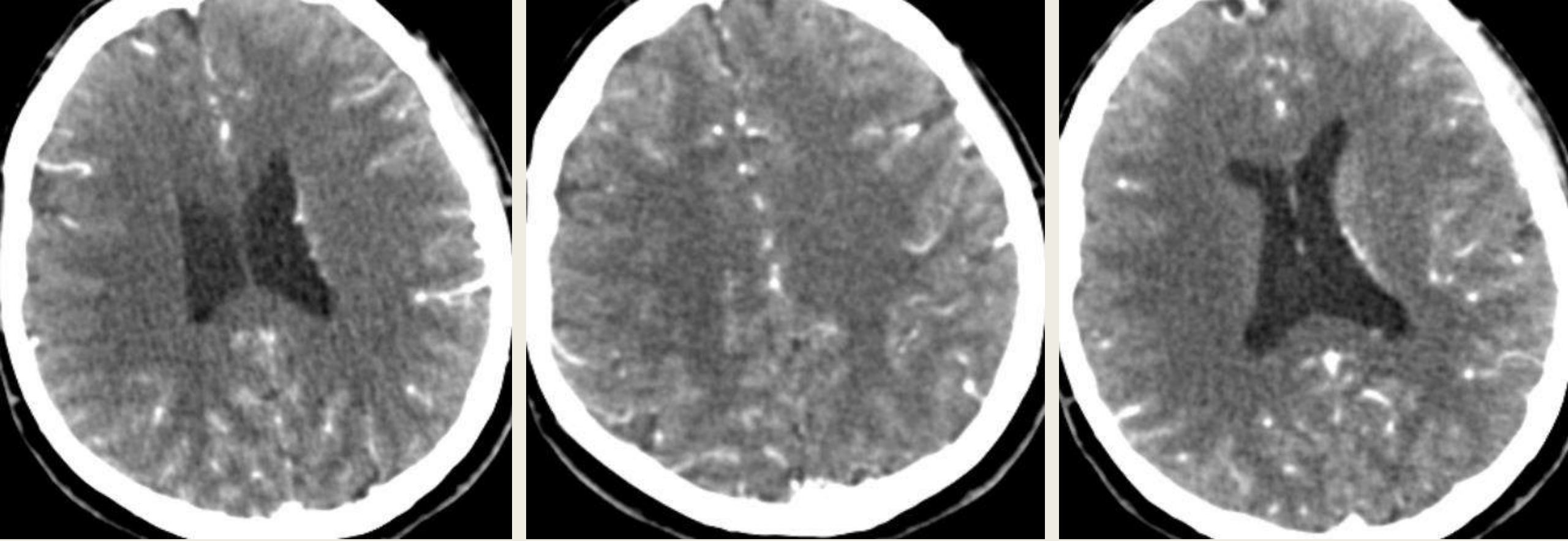

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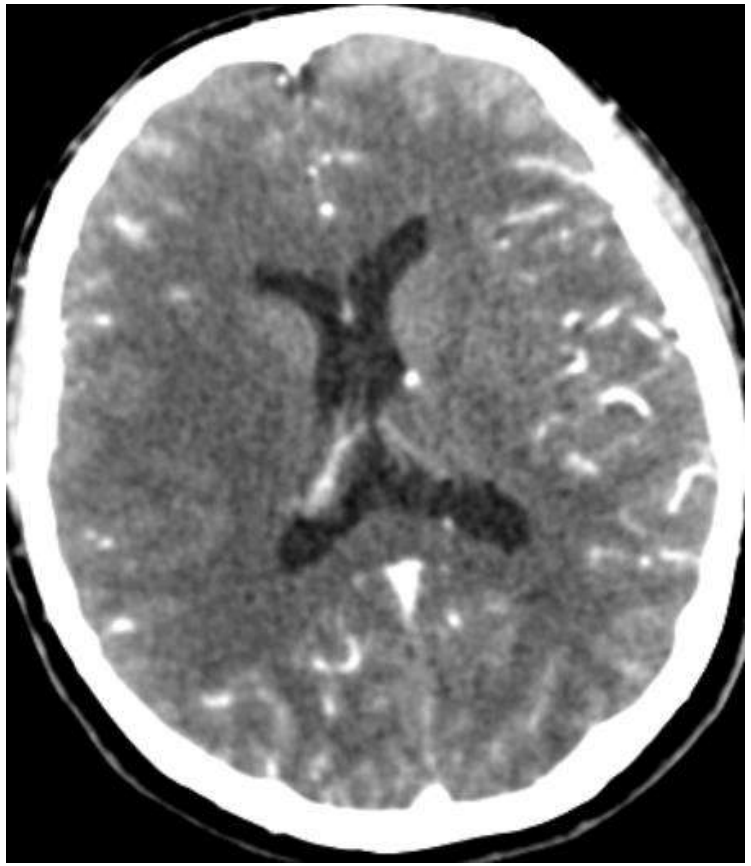
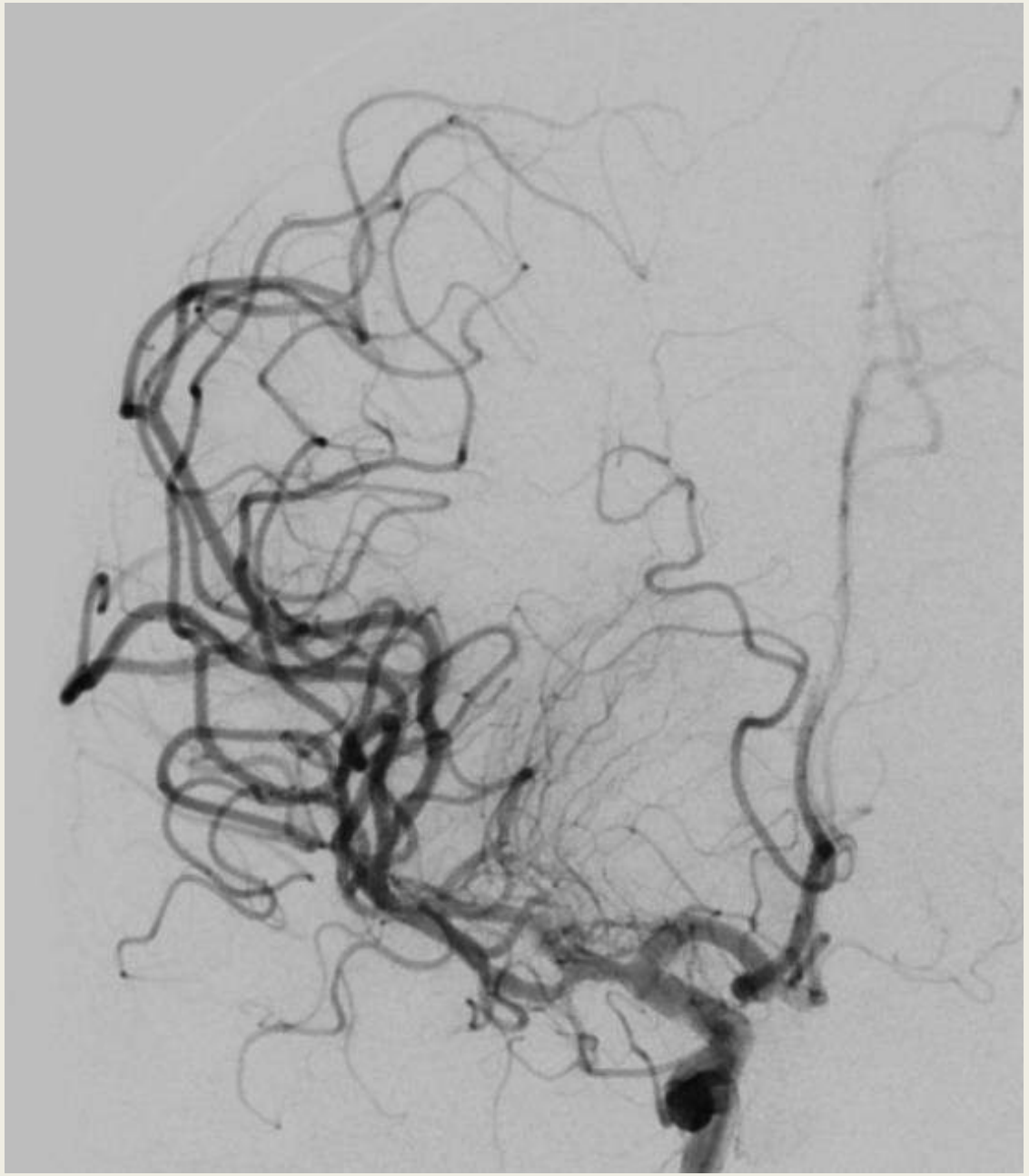
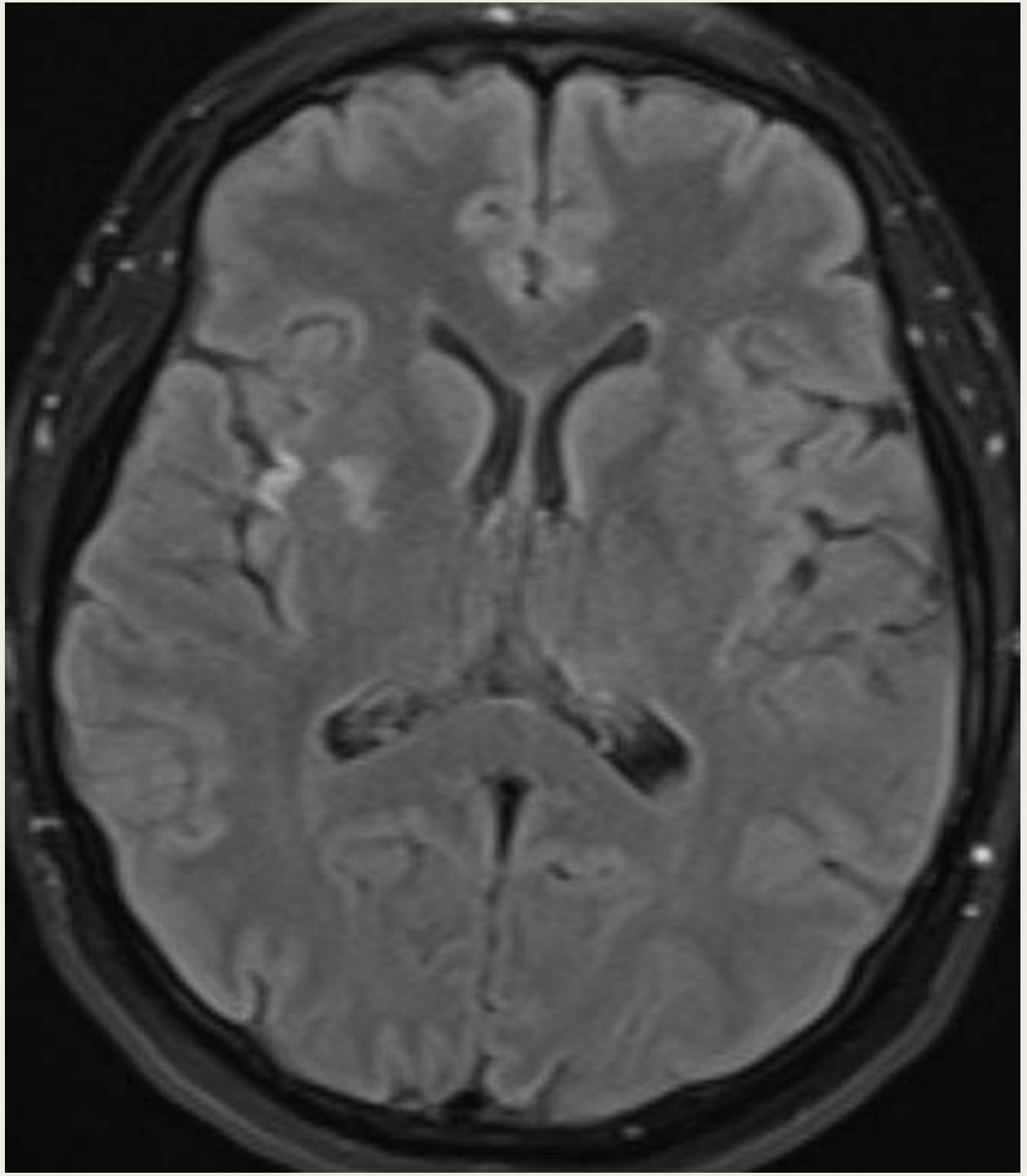
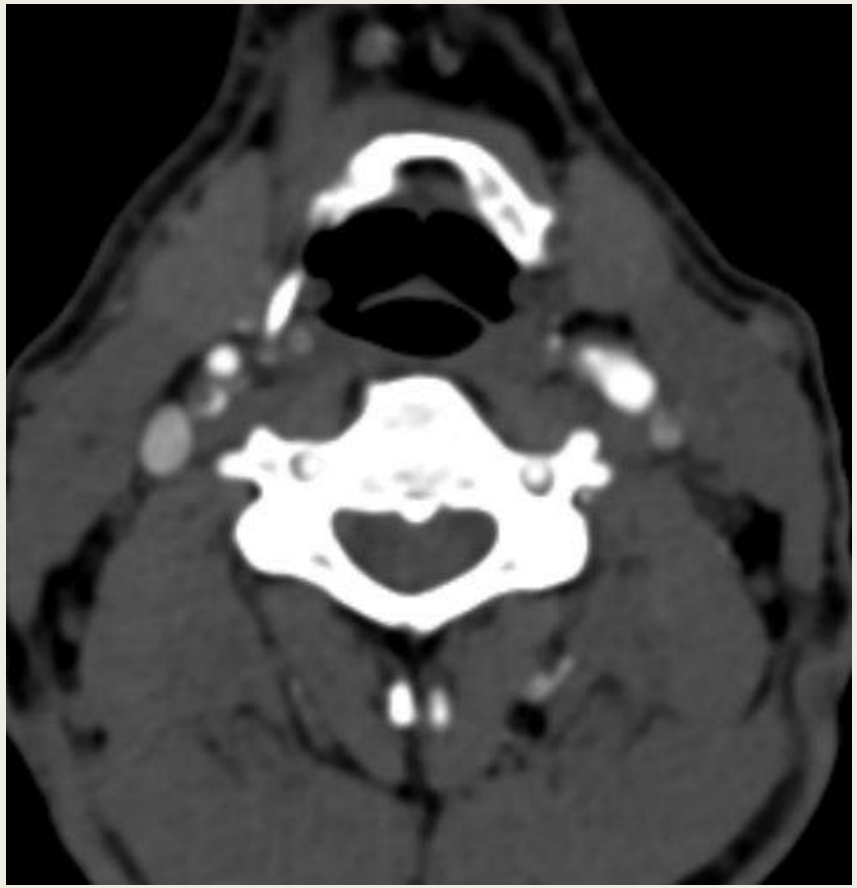
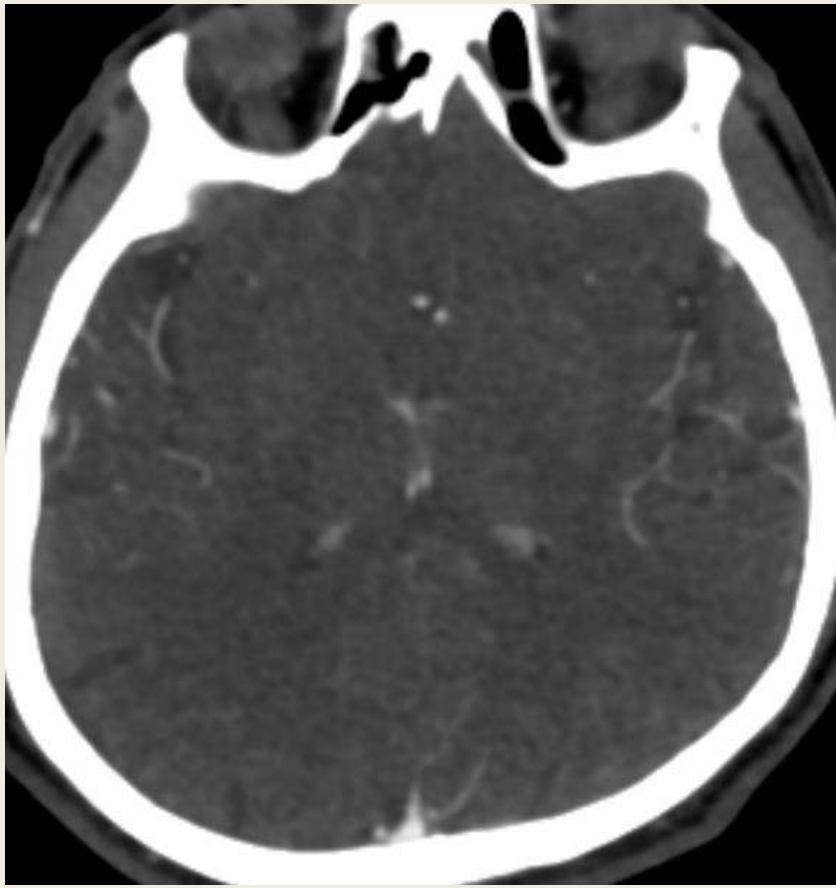


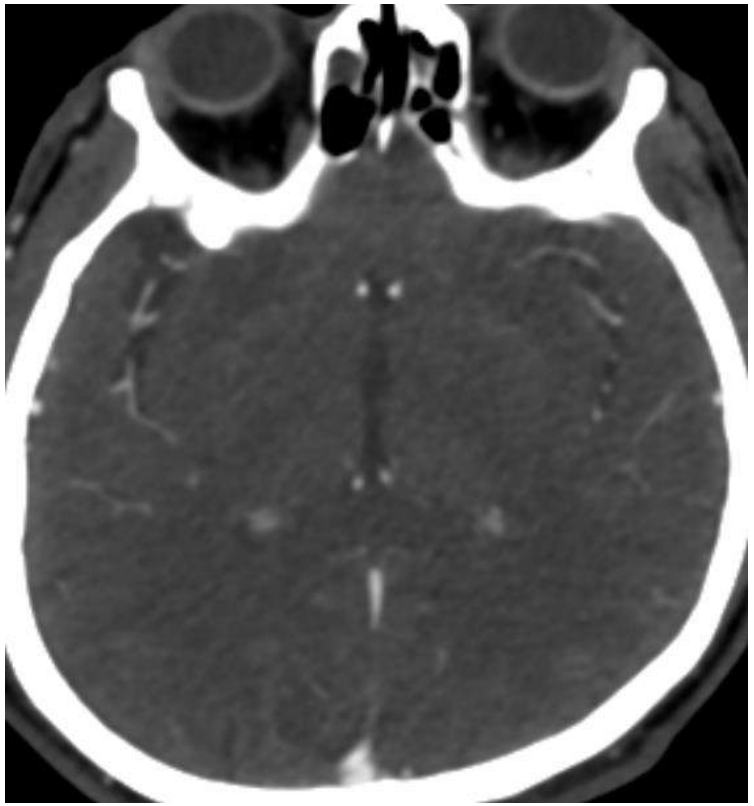
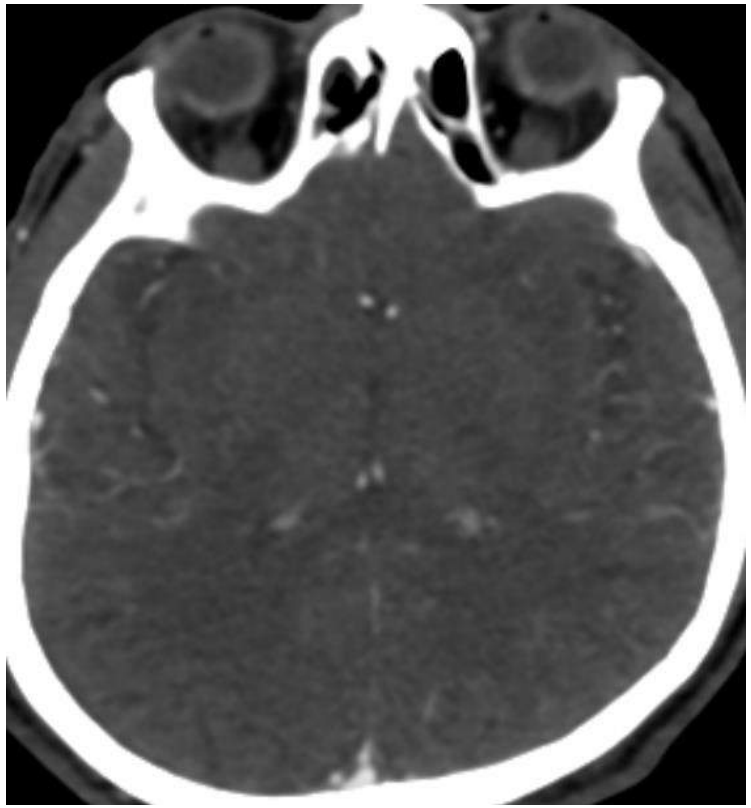


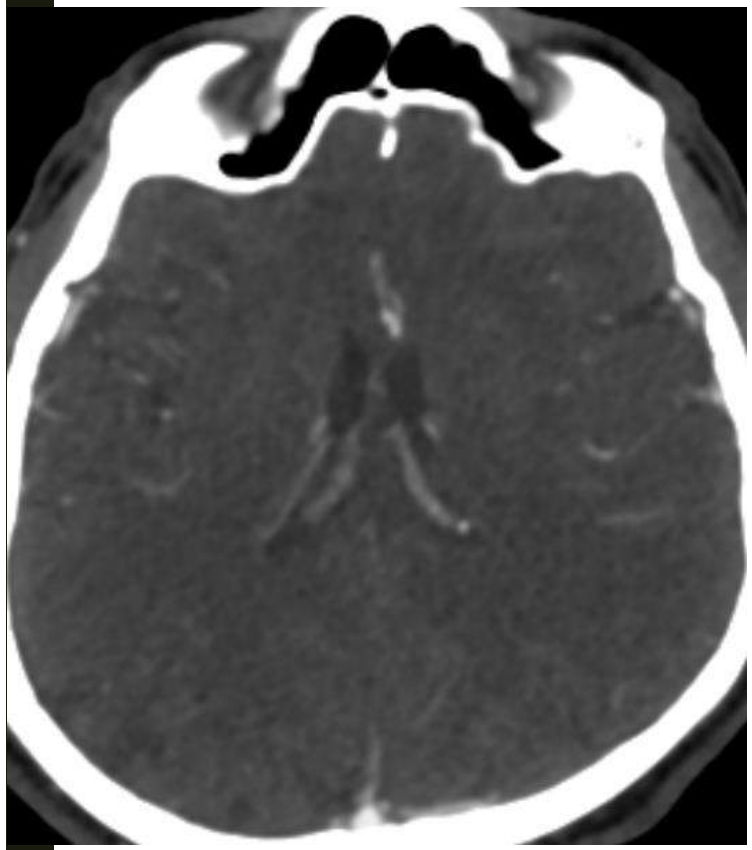


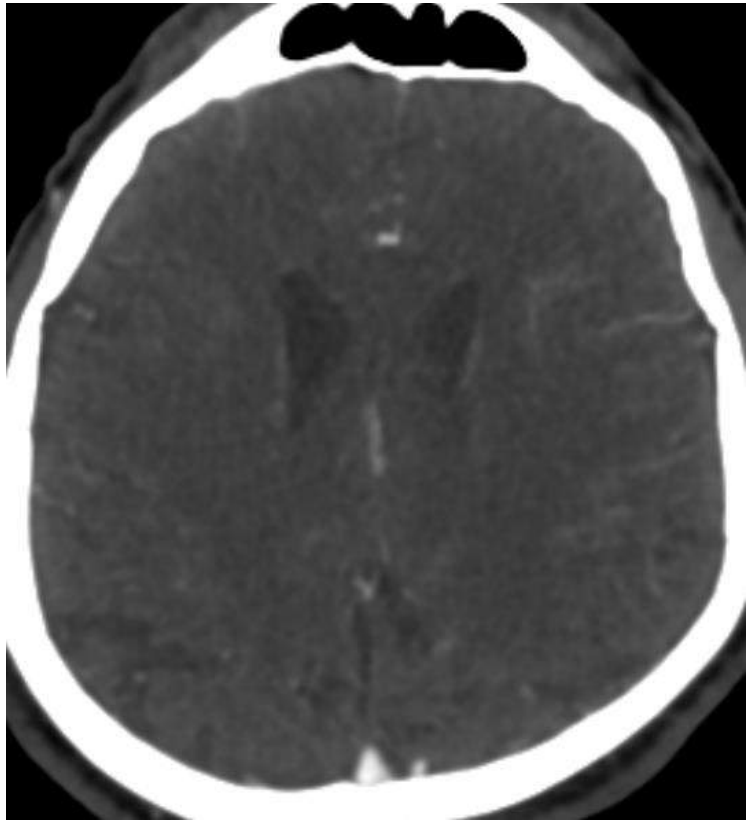


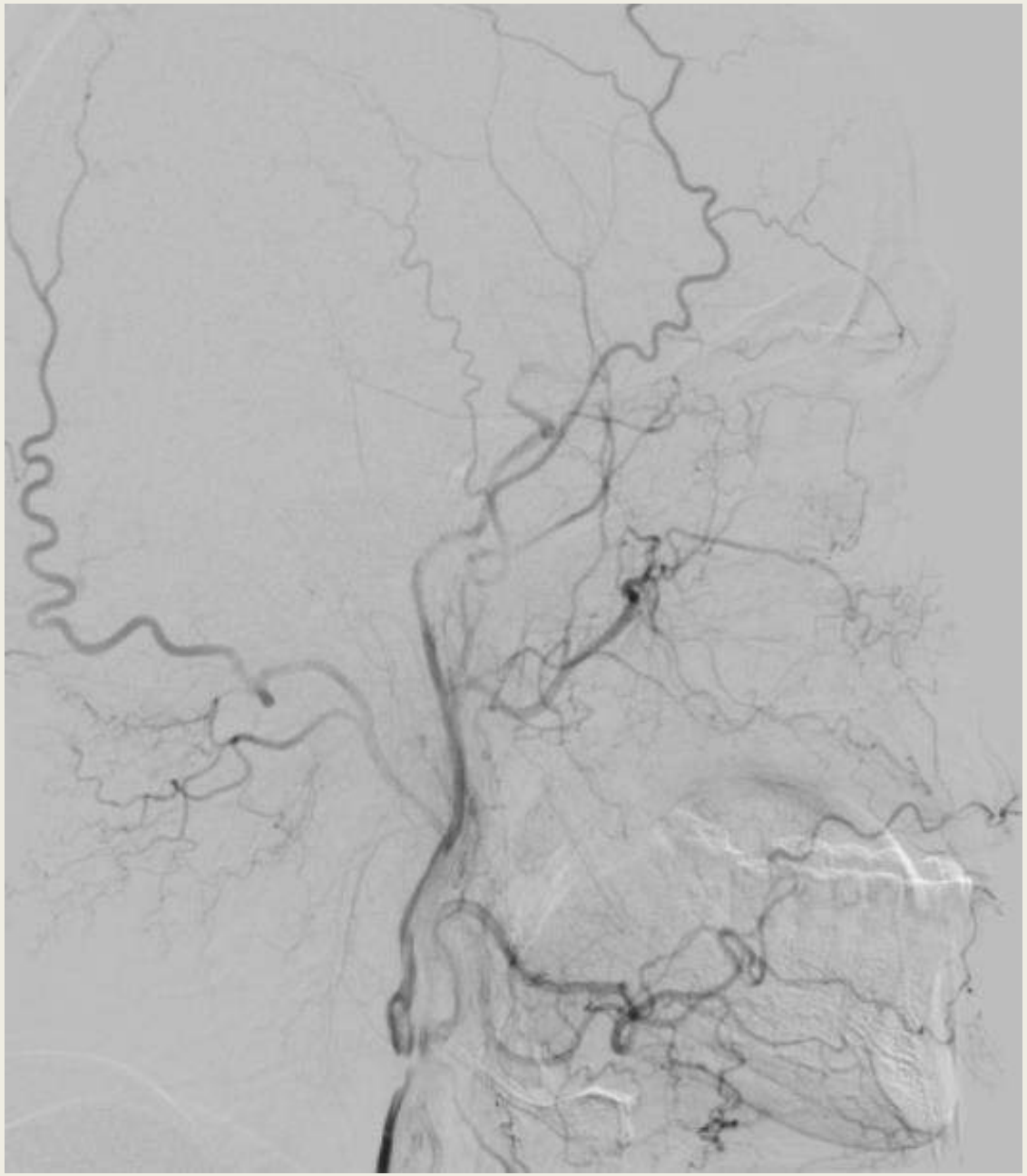


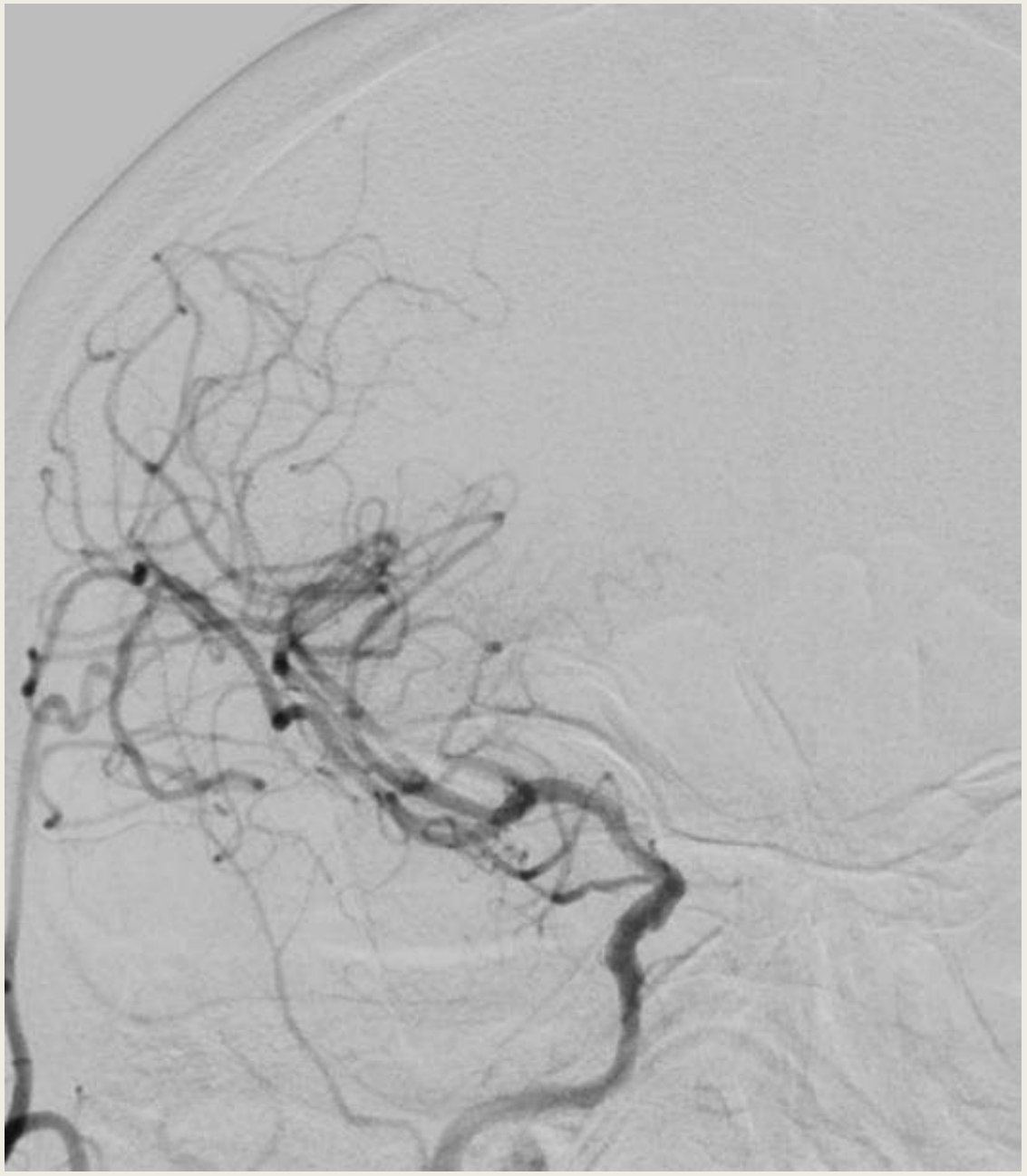
VAKA 3

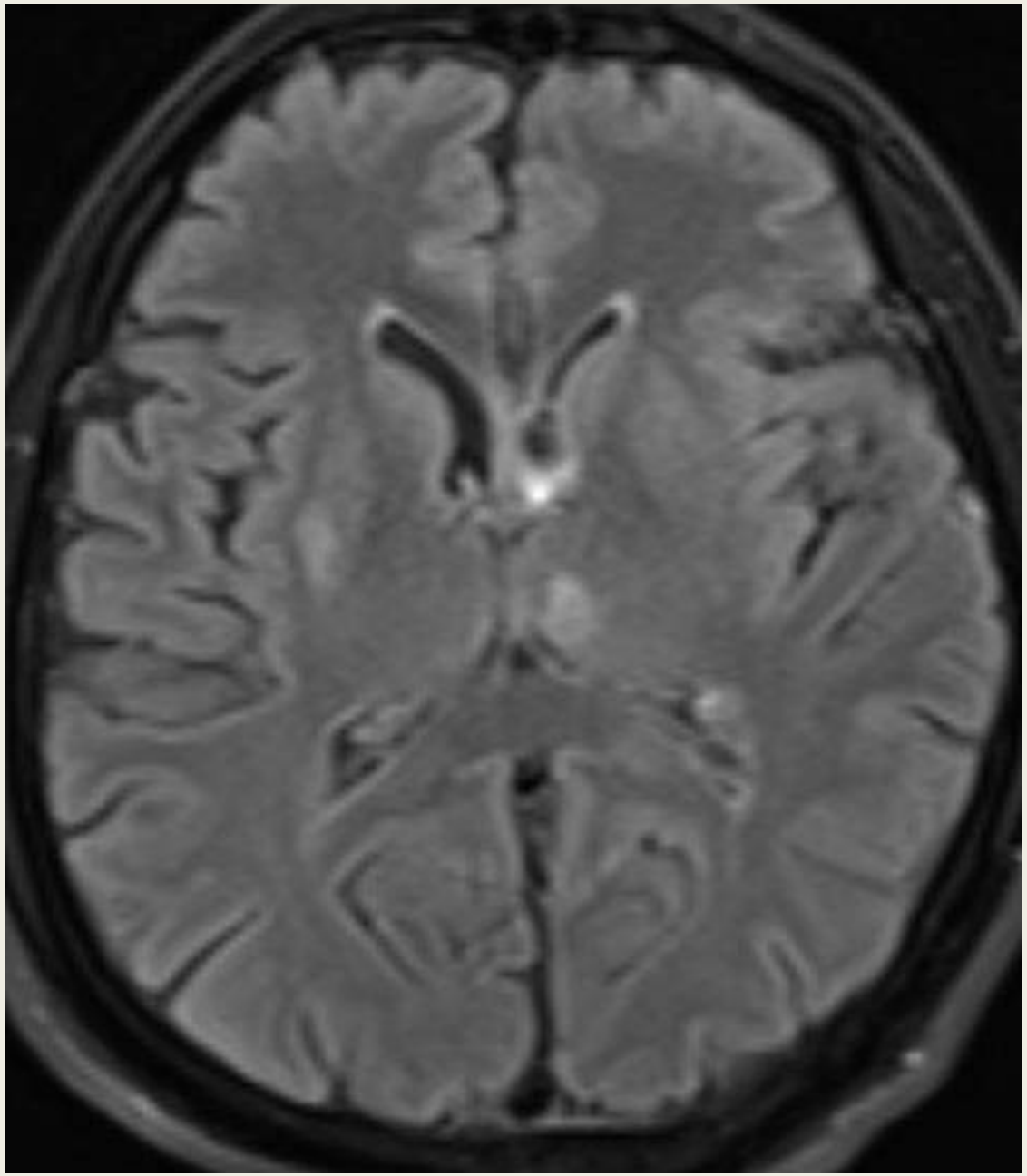




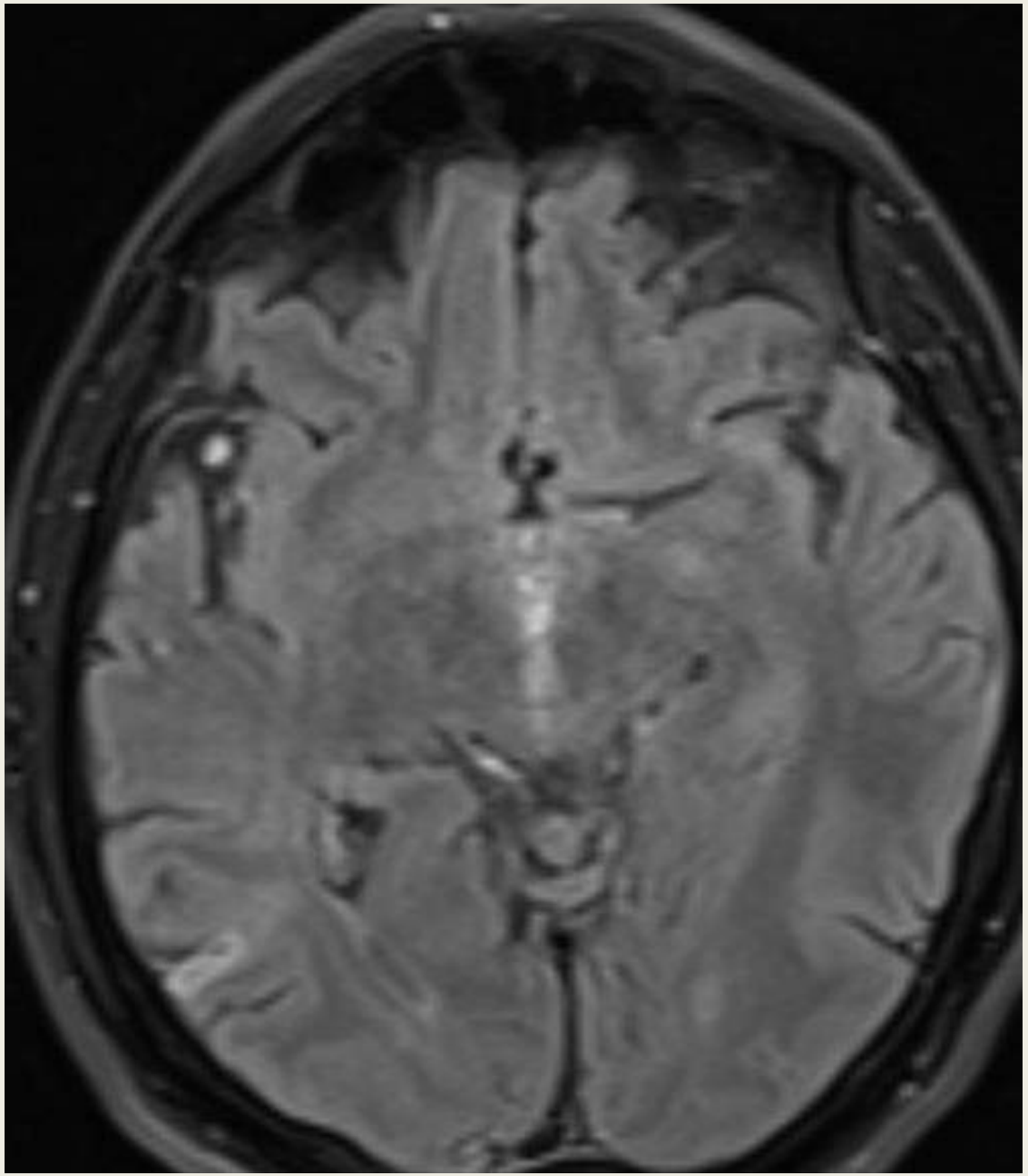












Akut Inmede BT, BT Angio ve BT Perfuzyon

Talip Asil

Memorial Hizmet Hastanesi

Inme Unitesi

Tedavi etmeden once

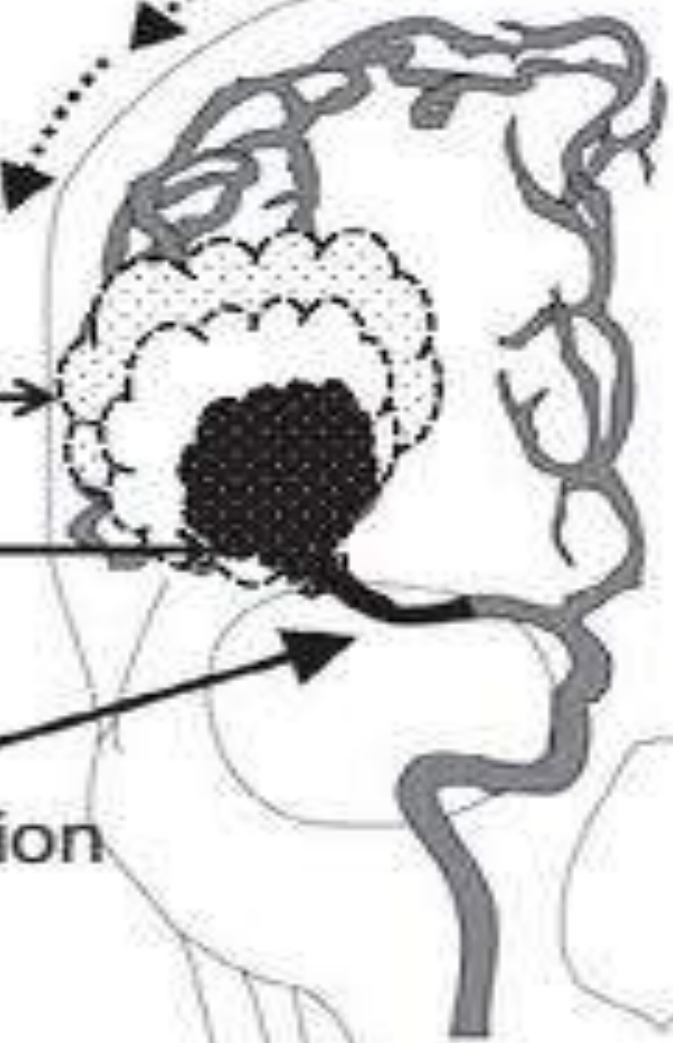
- **Clinical**
  - Inme Baslangic zamani
  - Inme Siddeti
- **Goruntuleme**
  - Clot lokalizasyonu
  - Core ve Kurtarilabilir doku (penumbra tahmini)
  - Colleteral skorlama

- 4C Kurali

Stroke Physiology & Imaging Methods

Core + Penumbra
- NIH Stroke Scale

Collateral Flow



Penumbra

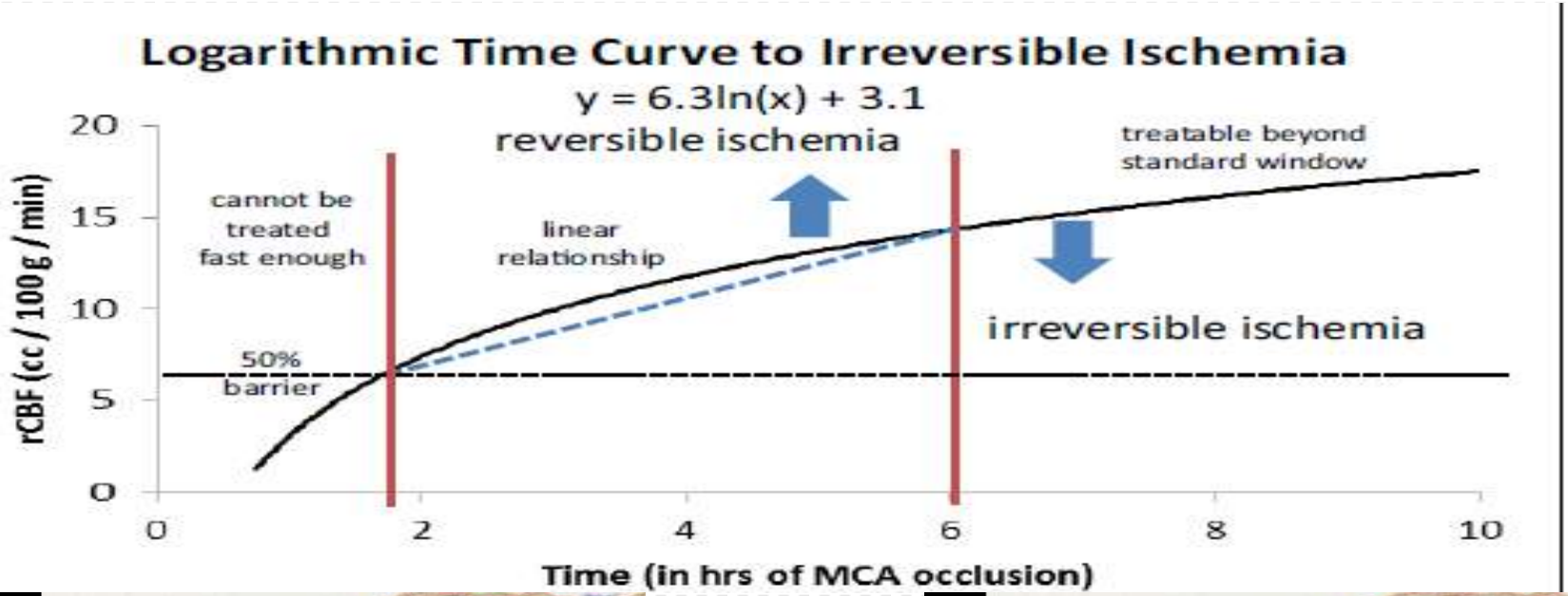
Core

MCA
Occulsion

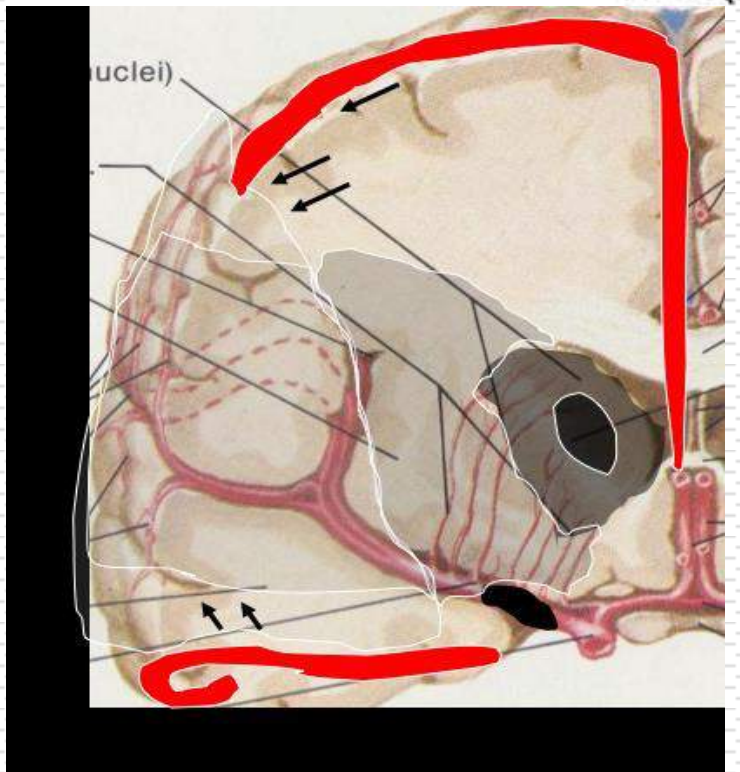
Penumbra
- DWI & NIHSS
- CTP
- MRP

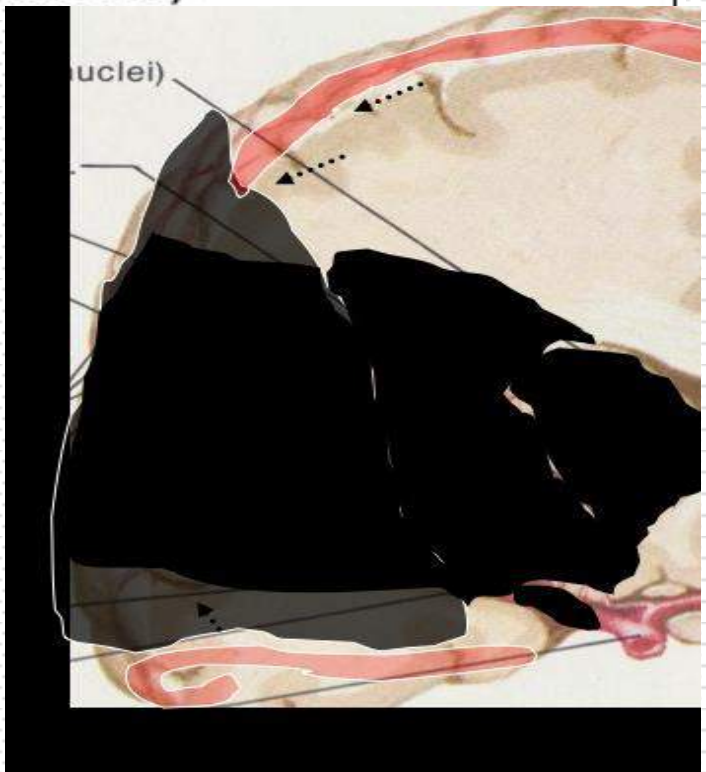
Core
- DWI
- CT
- CTA-SI
- CTP

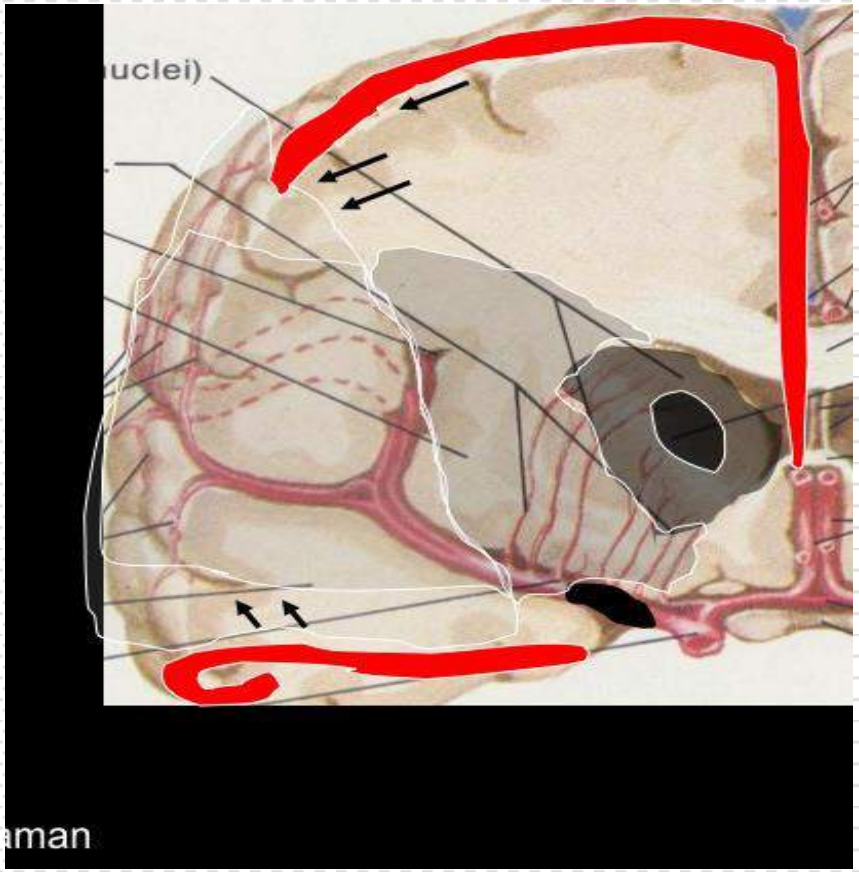
Occlusion
- CTA
- MRA

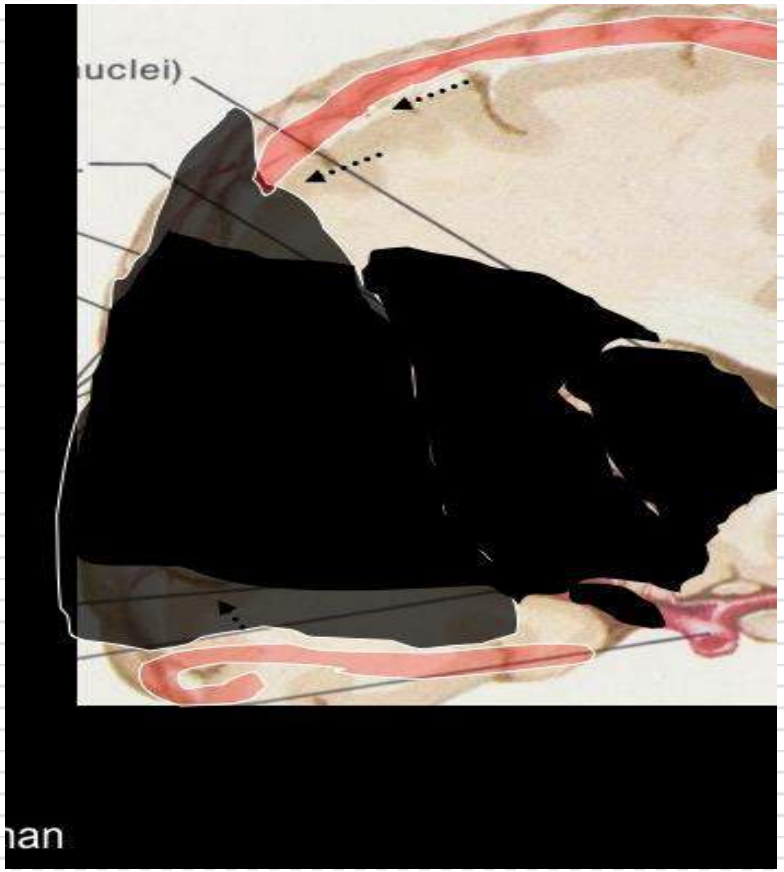

Logarithmic Time Curve to Irreversible Ischemia
y = 6.3ln(x) + 3.1
reversible ischemia
treatable beyond standard window
cannot be treated fast enough
linear relationship
irreversible ischemia
50% barrier
rCBF (cc / 100 g / min)
20
15
10
5
0
0
2
4
6
8
10
Time (in hrs of MCA occlusion)

Al Ali 2015









NIH Score = NIH Score

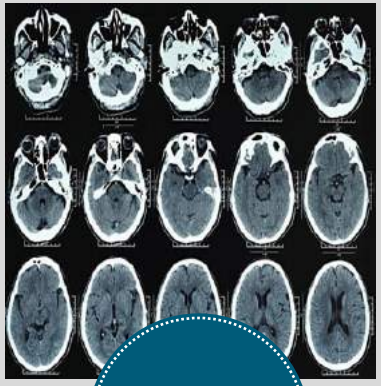
Klinik-Goruntuleme Mismatch

Nuts and Bolts of NIH Stroke scale

1. Tool used by healthcare providers to objectively quantify impairment caused by stroke.
1. Initially designed as a research tool and then incorporated into Acute stroke evaluation.
1. A trained provider administers the NIHSS which usually takes about 10 min.
1. Scale consists of 11 items and each item ranges from 0-5 where 0 is normal and 5 means severely affected.
1. Maximum possible score is 42.

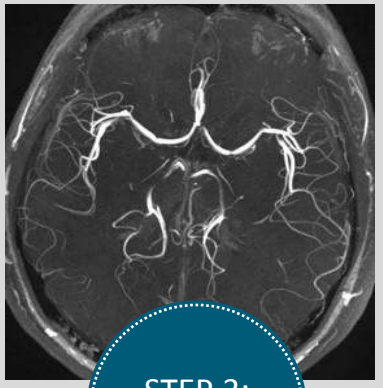
Score	Stroke severity
0 symptoms	No stroke
1-4 Stroke	Minor
5-15 Stroke	Moderate
16-20 to severe Stroke	Moderate
21-42	Severe

İlk 4.5-6 Saat



STEP 1:
Plain CT

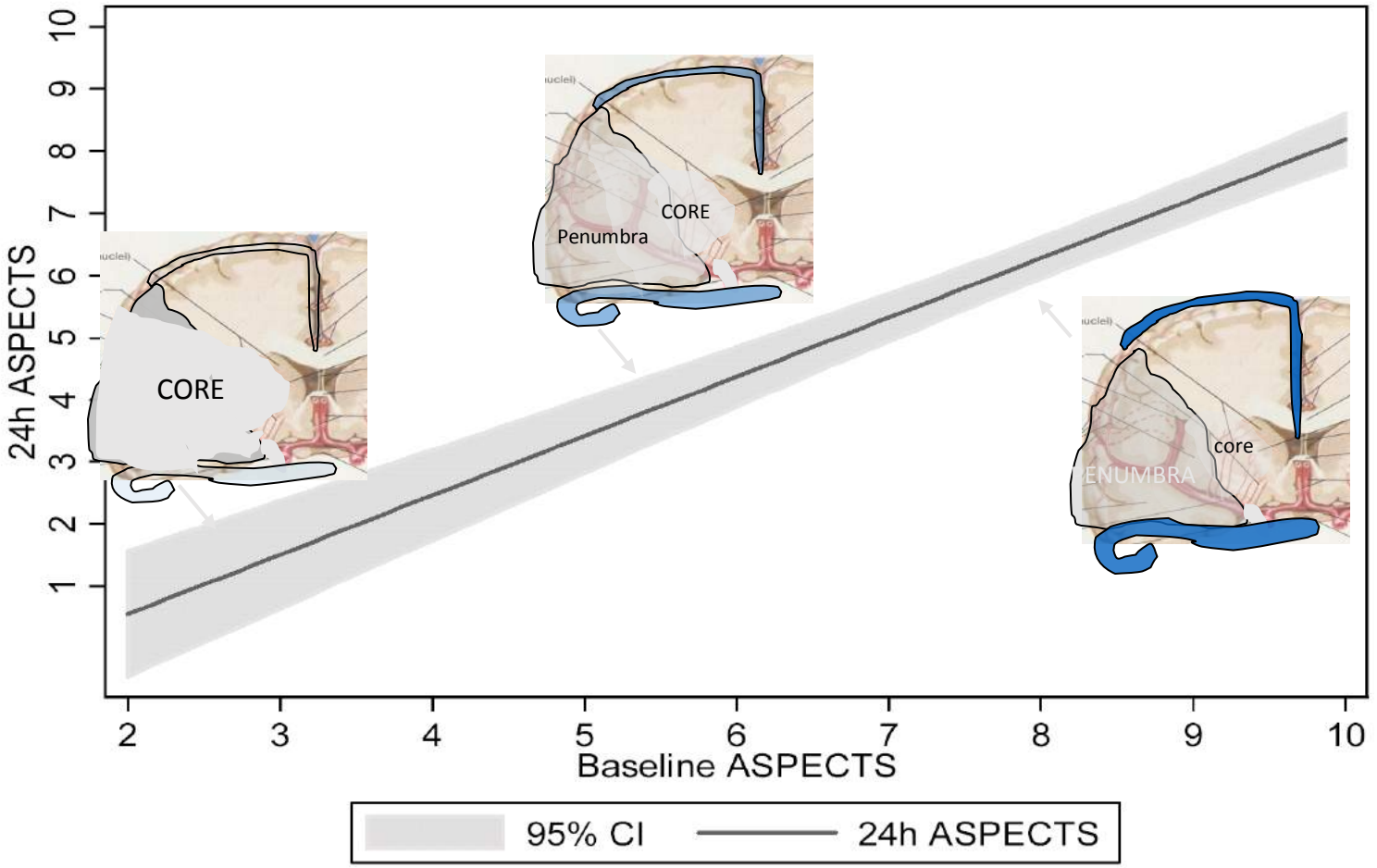
STEP 2:
rt-PA



STEP 3:
CT Angio

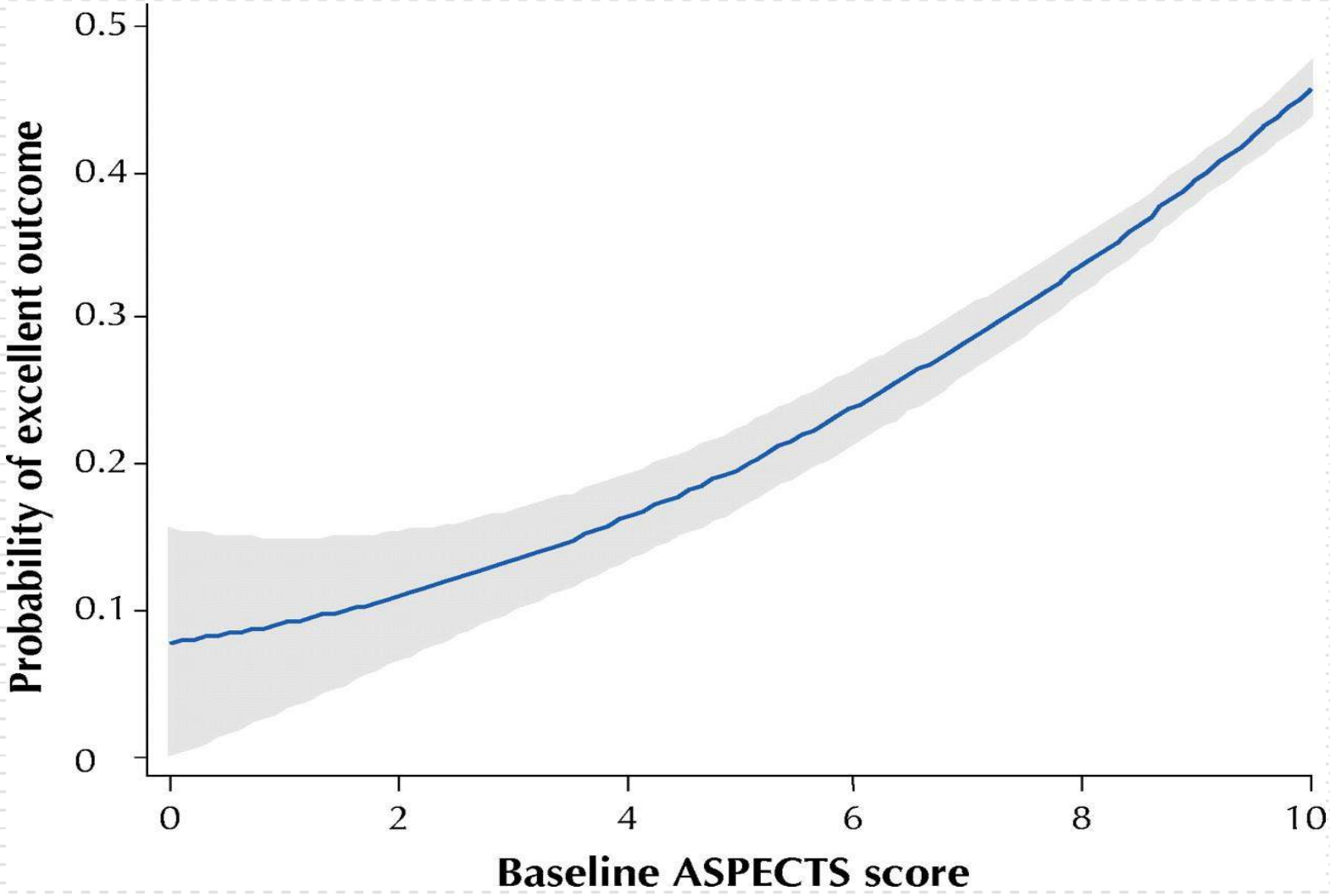
STEP 4:
Endovascular

Dzialowski I et al. ASPECTS ECASS-2. Stroke

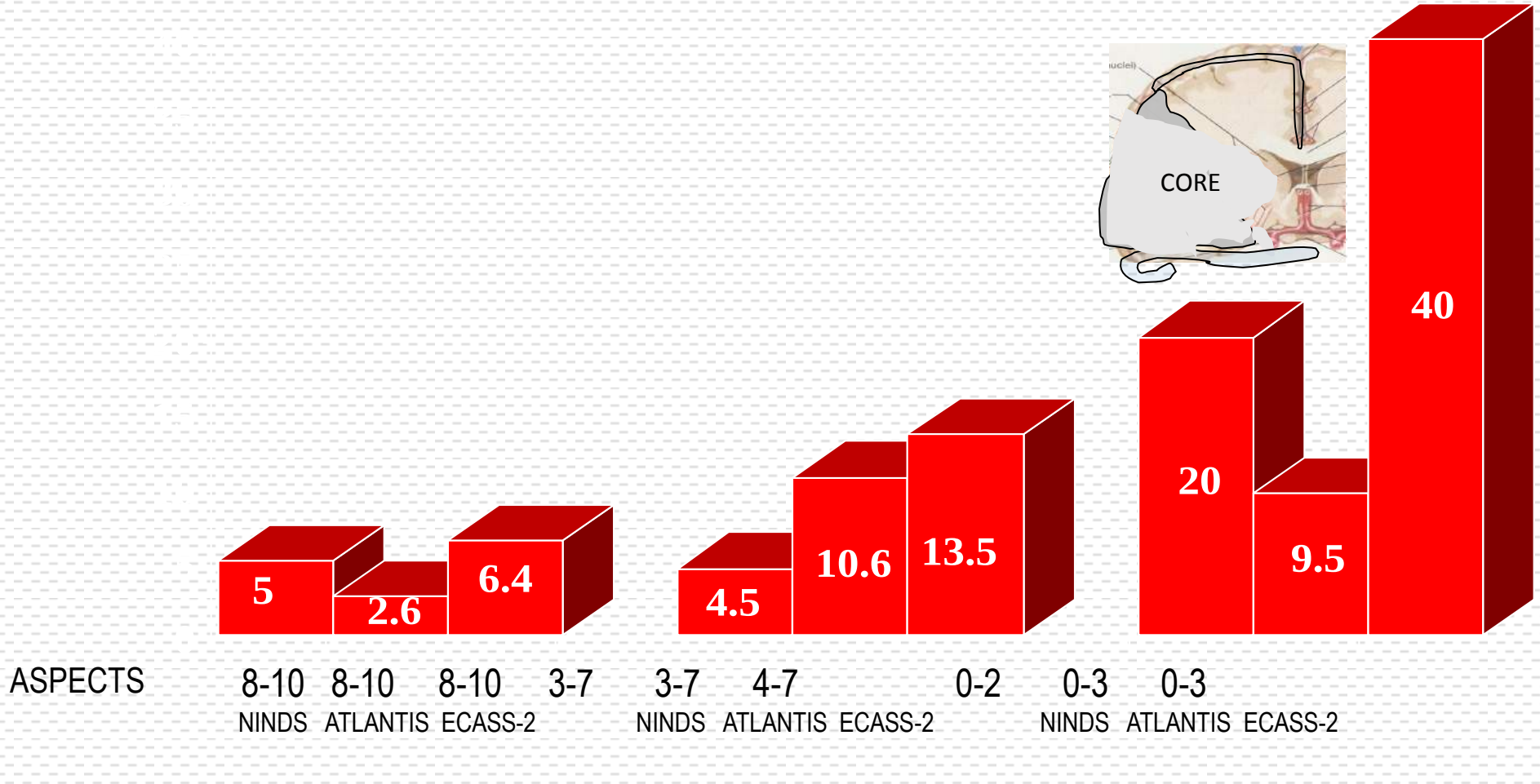


ASPECTS clinical outcome

Hill MD et al. CASES. CMAJ 2005



ASPECT Skoru- sICH Iliskisi



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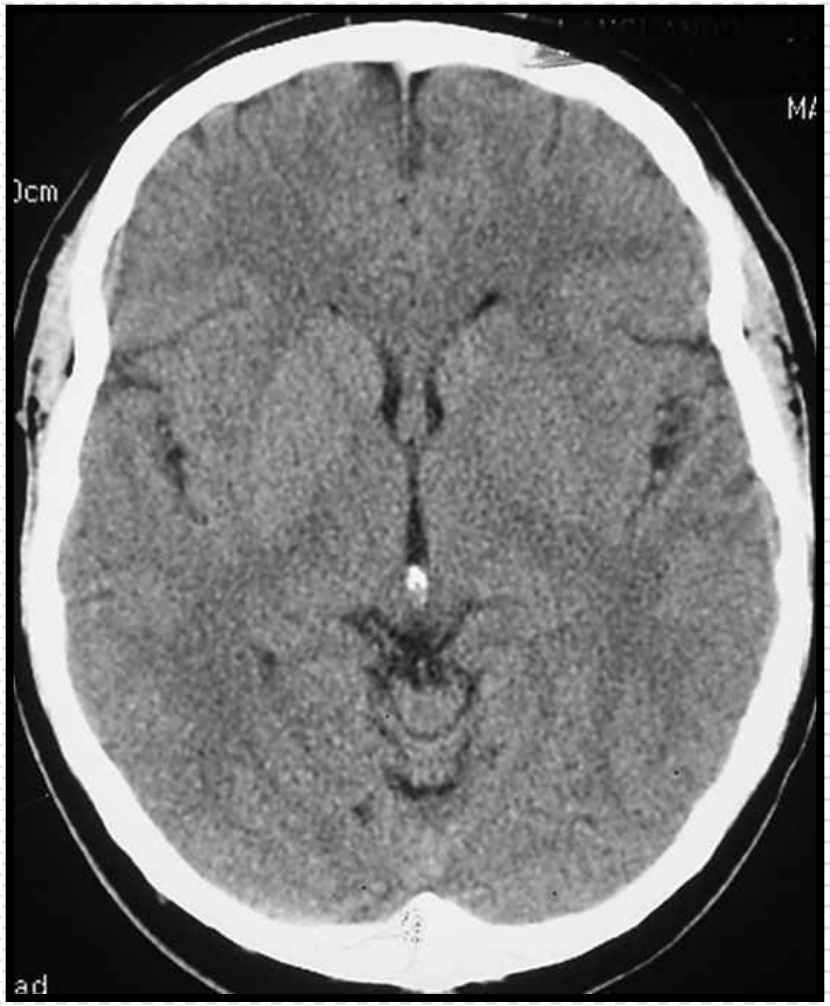

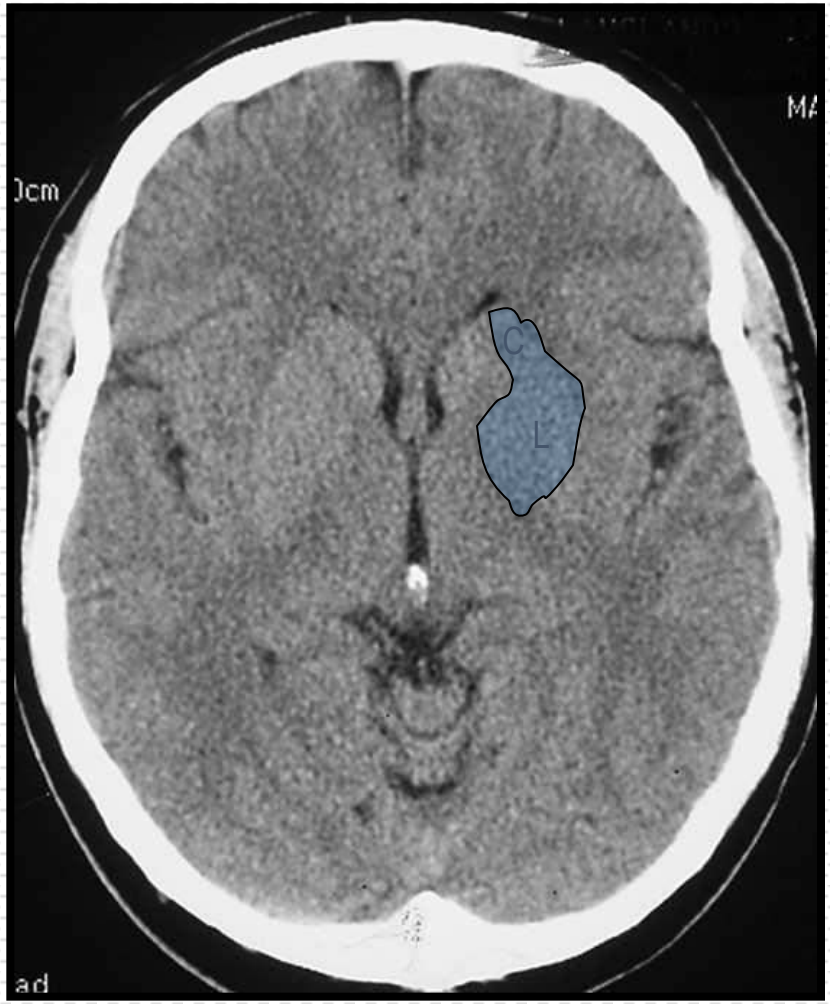
C
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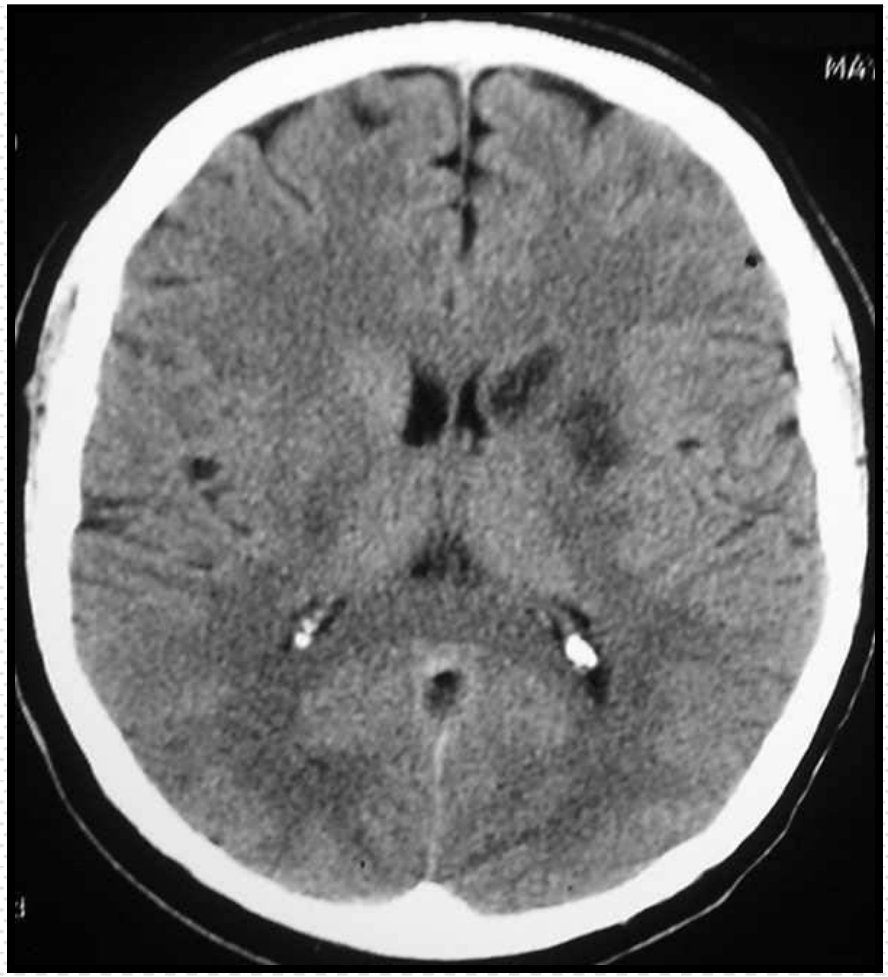
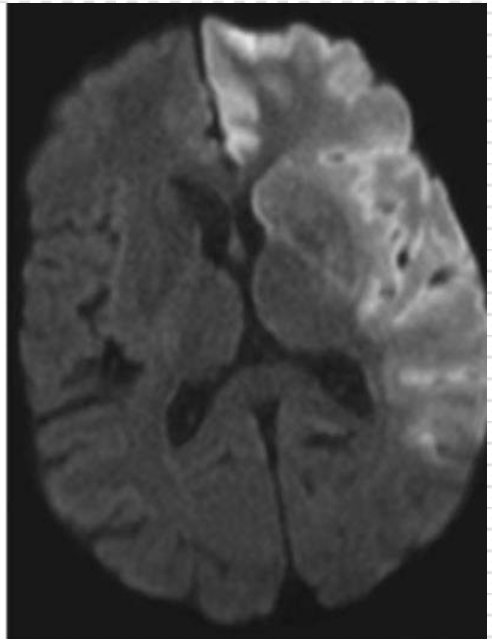
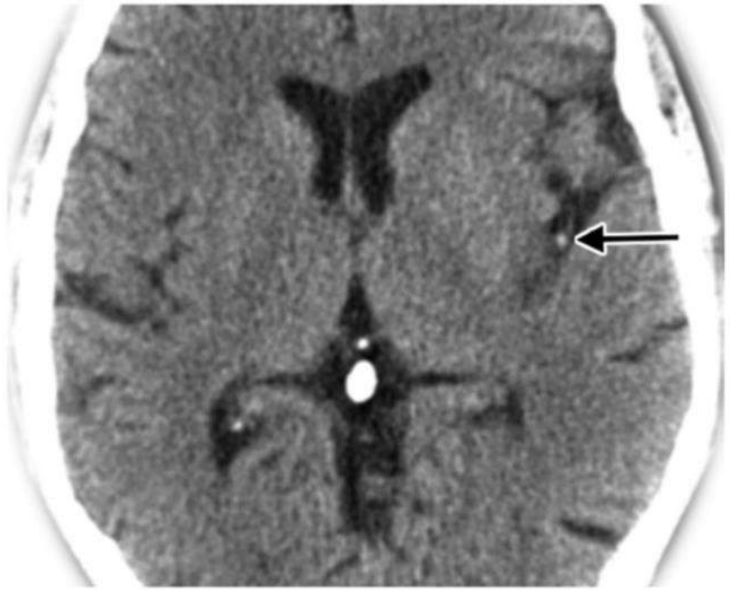
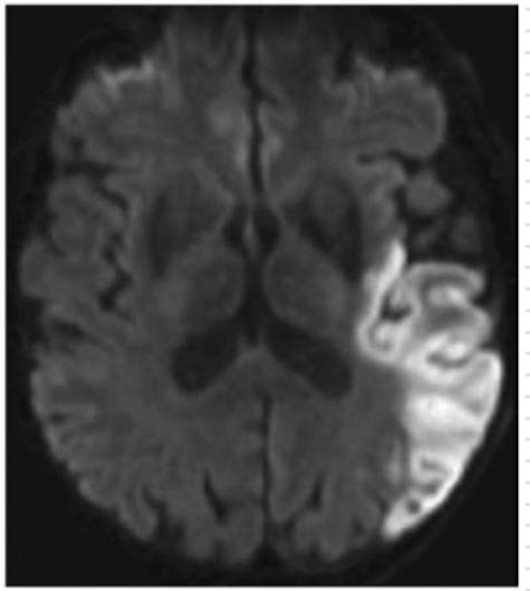
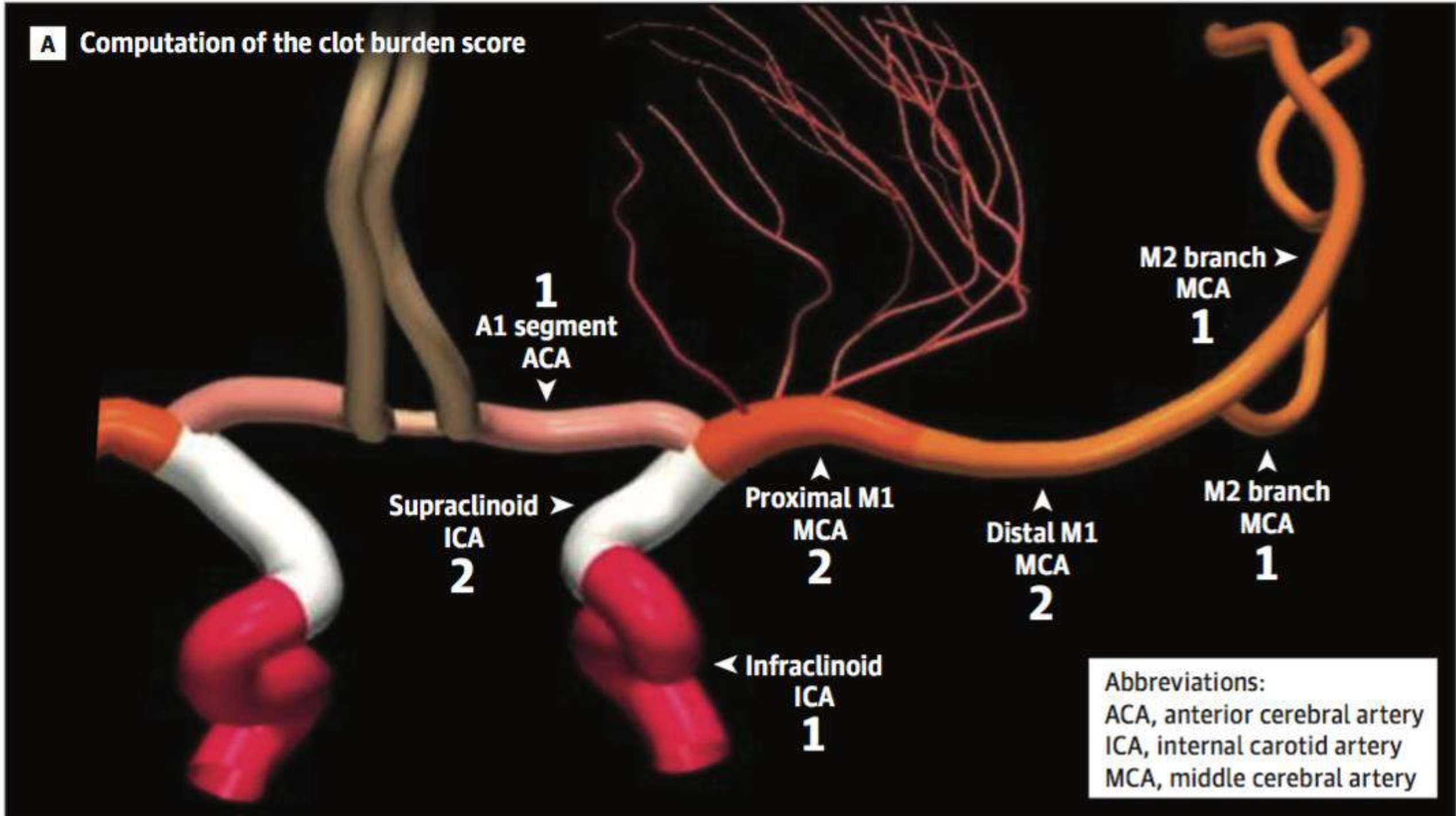
24. saat



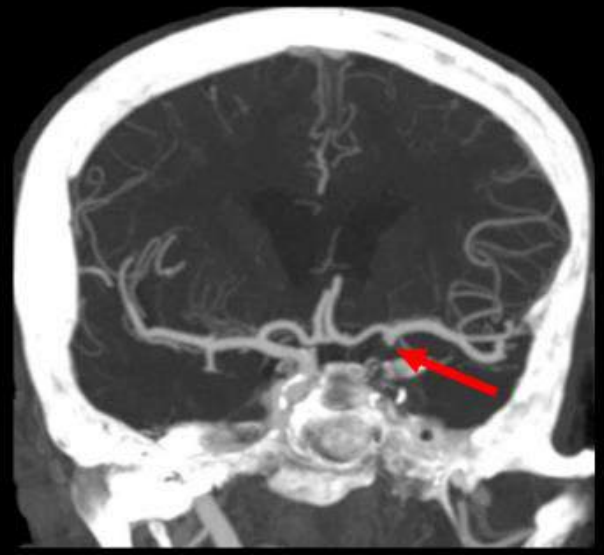




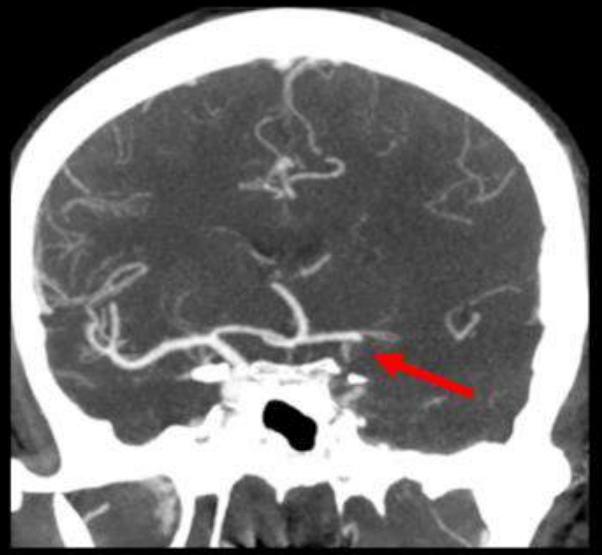



A Computation of the clot burden score
1
A1 segment
ACA
M2 branch
MCA
1
Supraclinoid
ICA
2
Proximal M1
MCA
2
Distal M1
MCA
2
M2 branch
MCA
1
Infraclinoid
ICA
1
Abbreviations:
ACA, anterior cerebral artery
ICA, internal carotid artery
MCA, middle cerebral artery

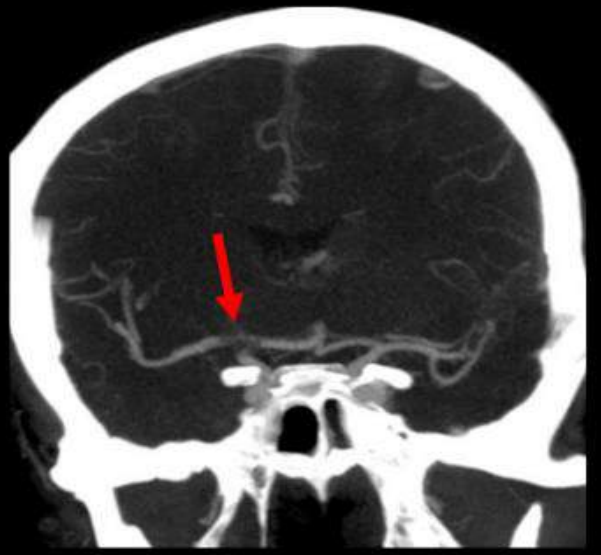
Terminal ICA I Occlusion



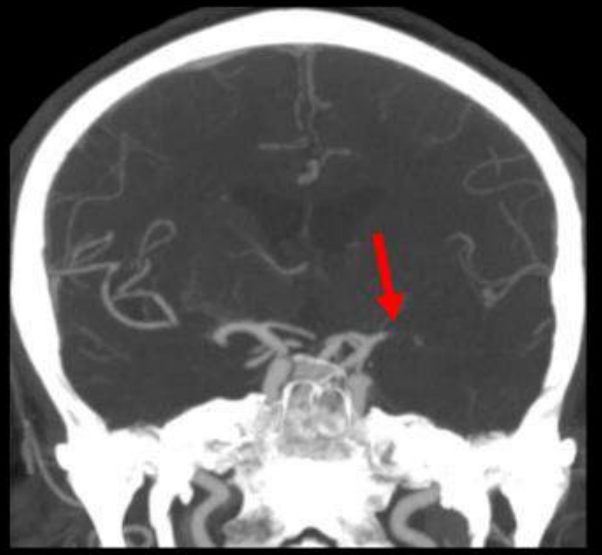
Terminal ICA L Occlusion



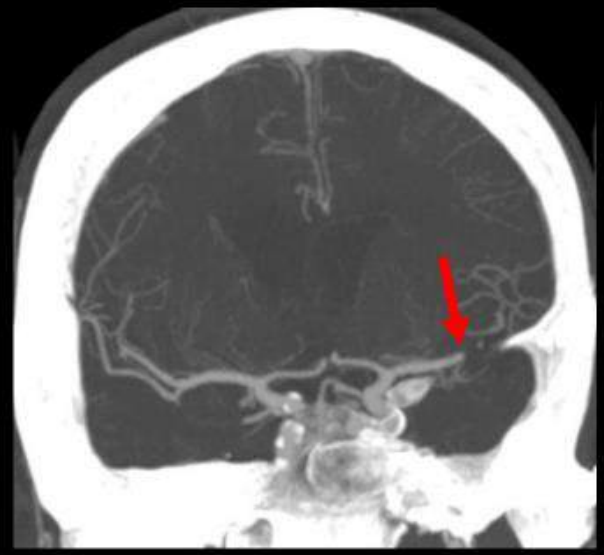
Terminal ICA T Occlusion



Proximal M1 Occlusion

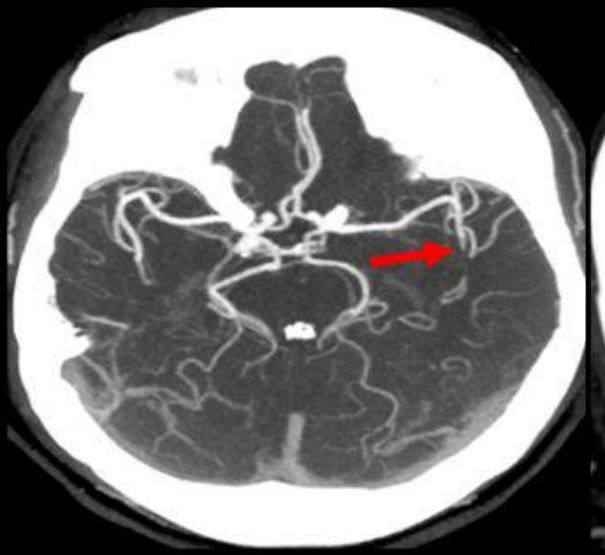


Distal M1 Occlusion

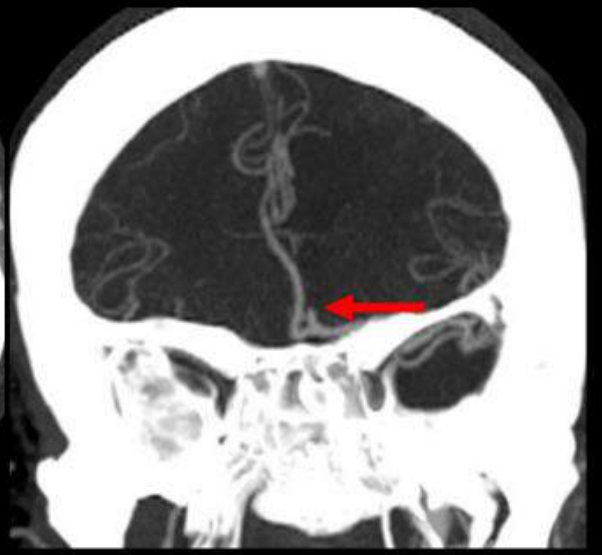


Proximal M2 Occlusion

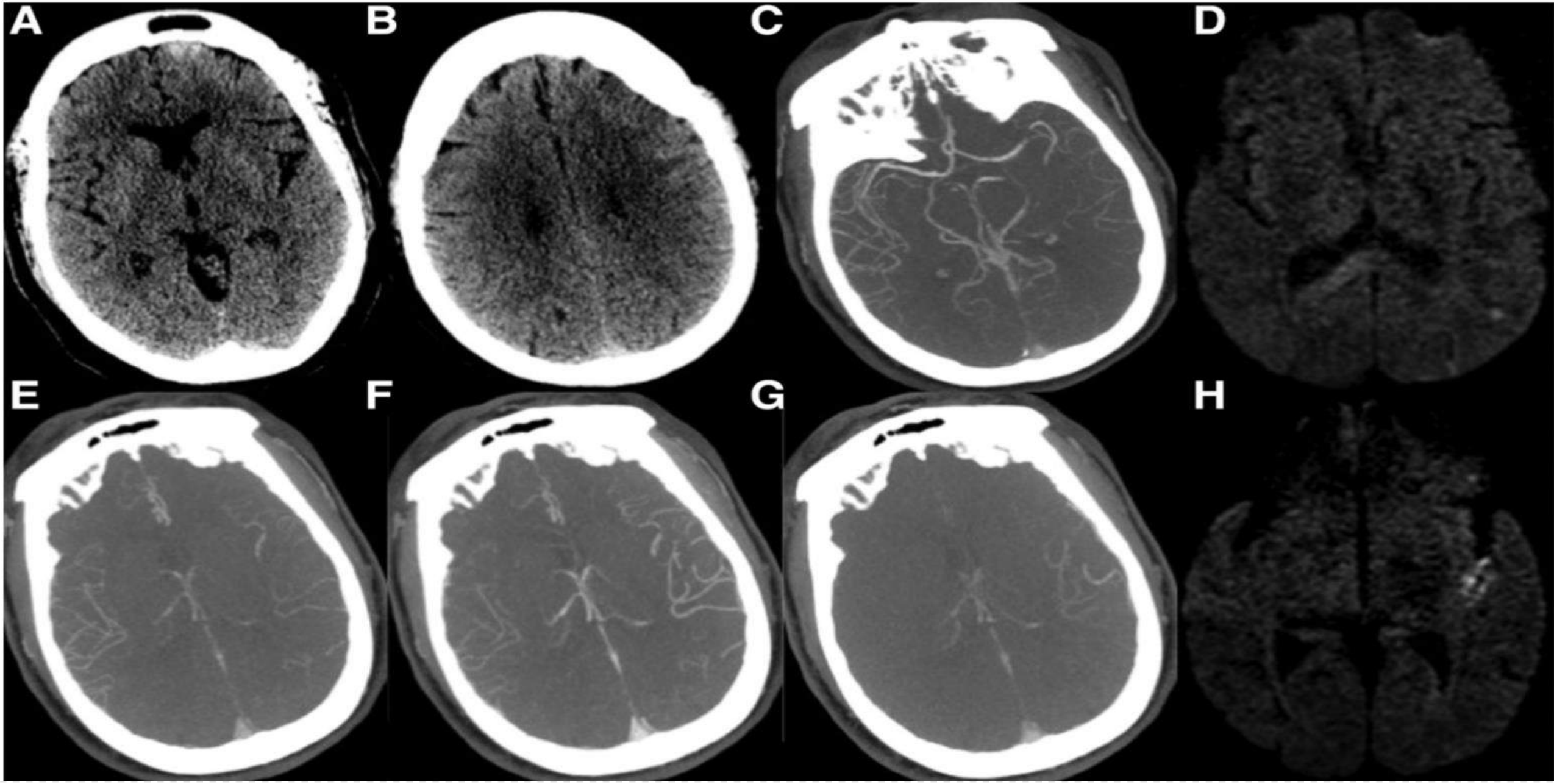
Distal M2 Occlusion



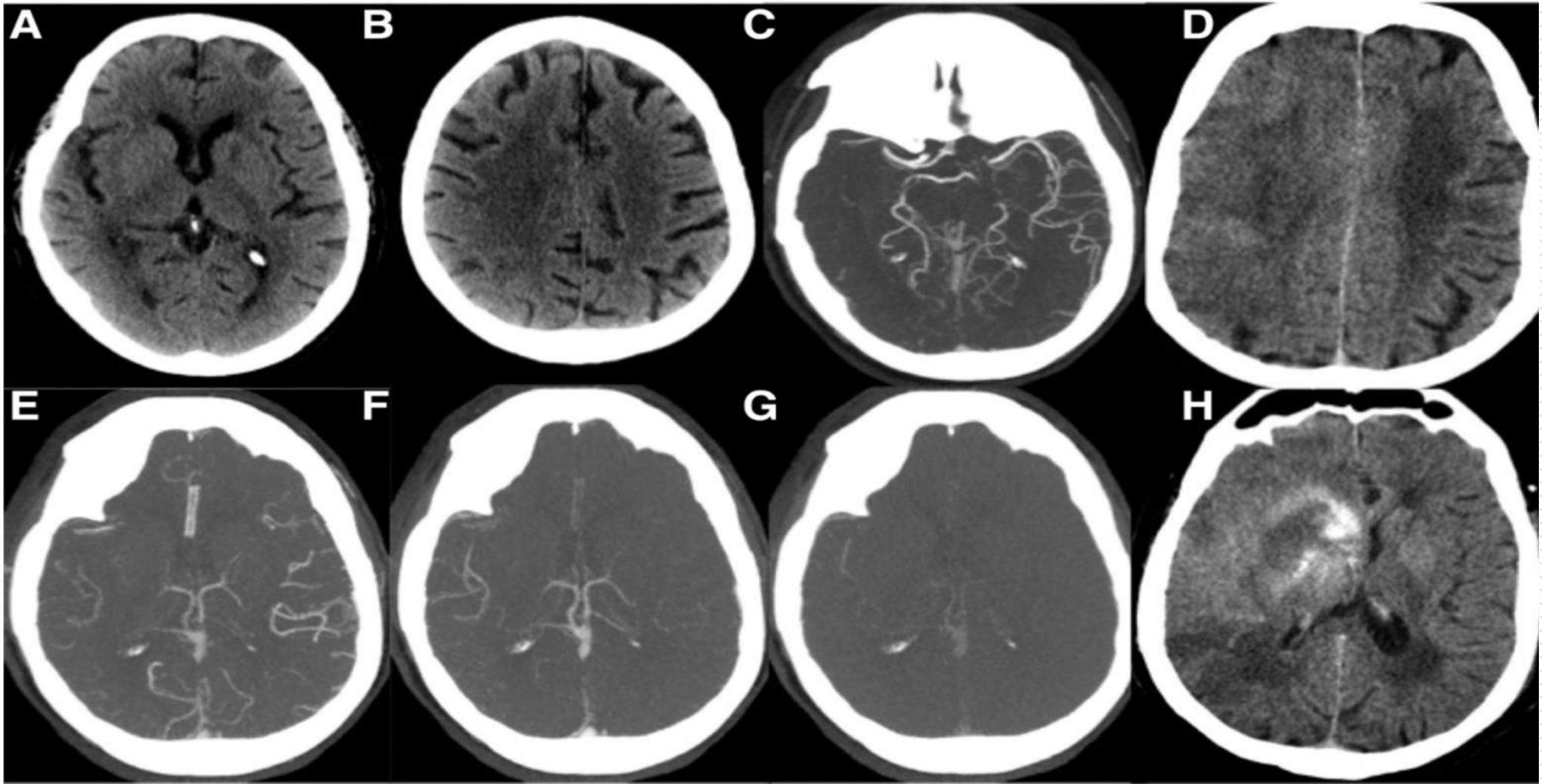
ACA A2 Occlusion

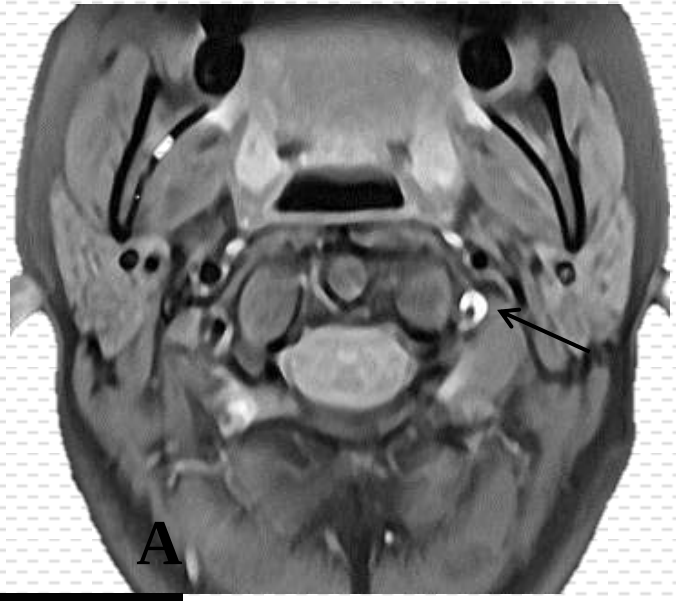


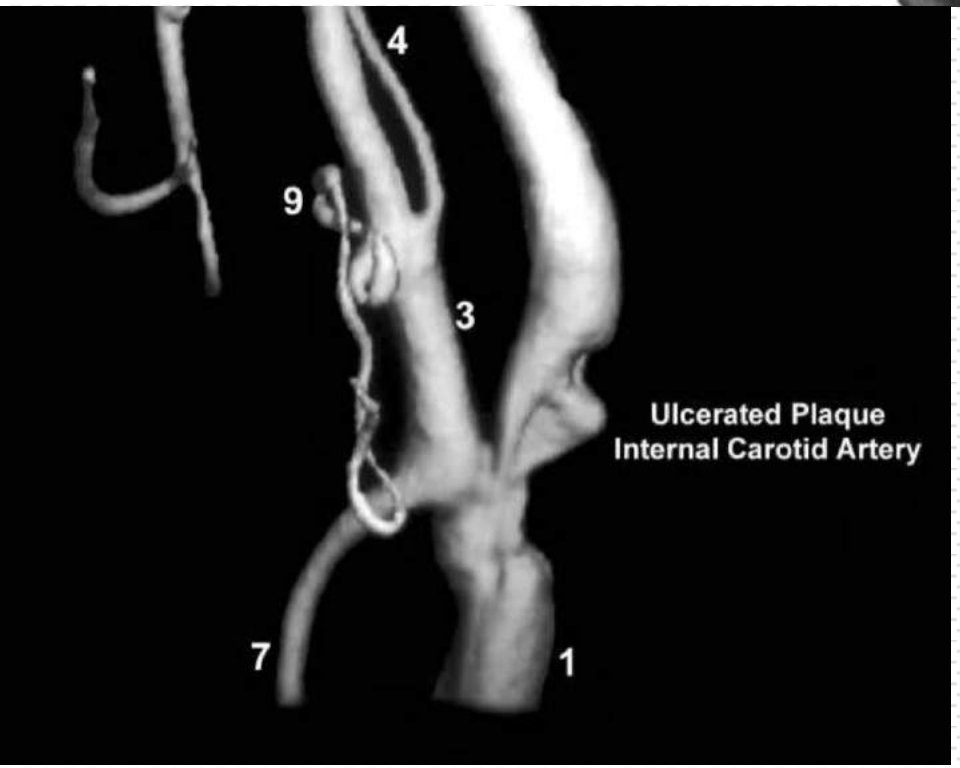
Iyi Kolleteral

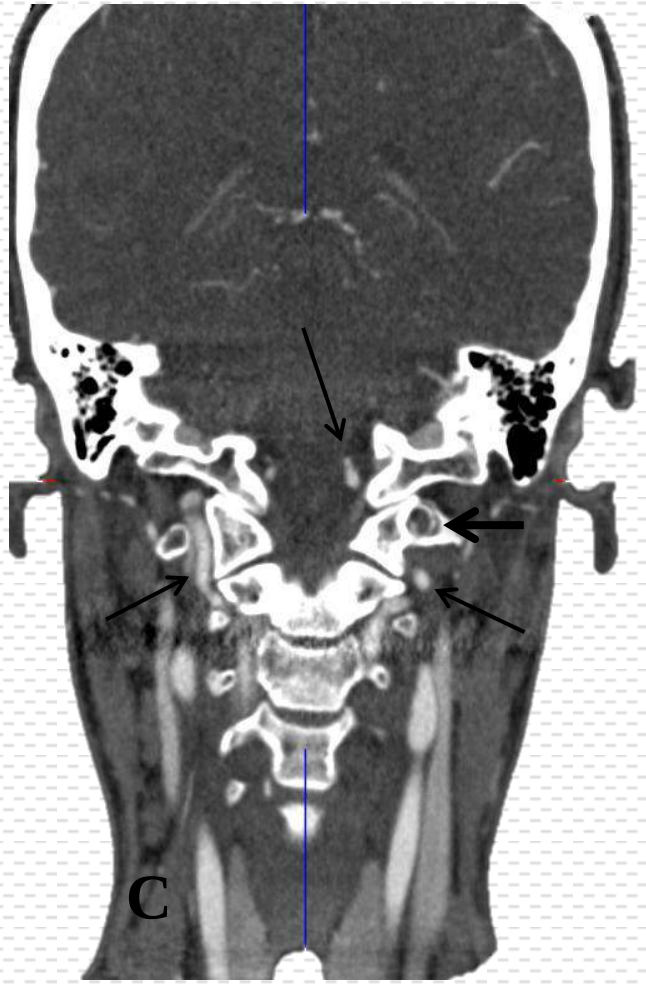


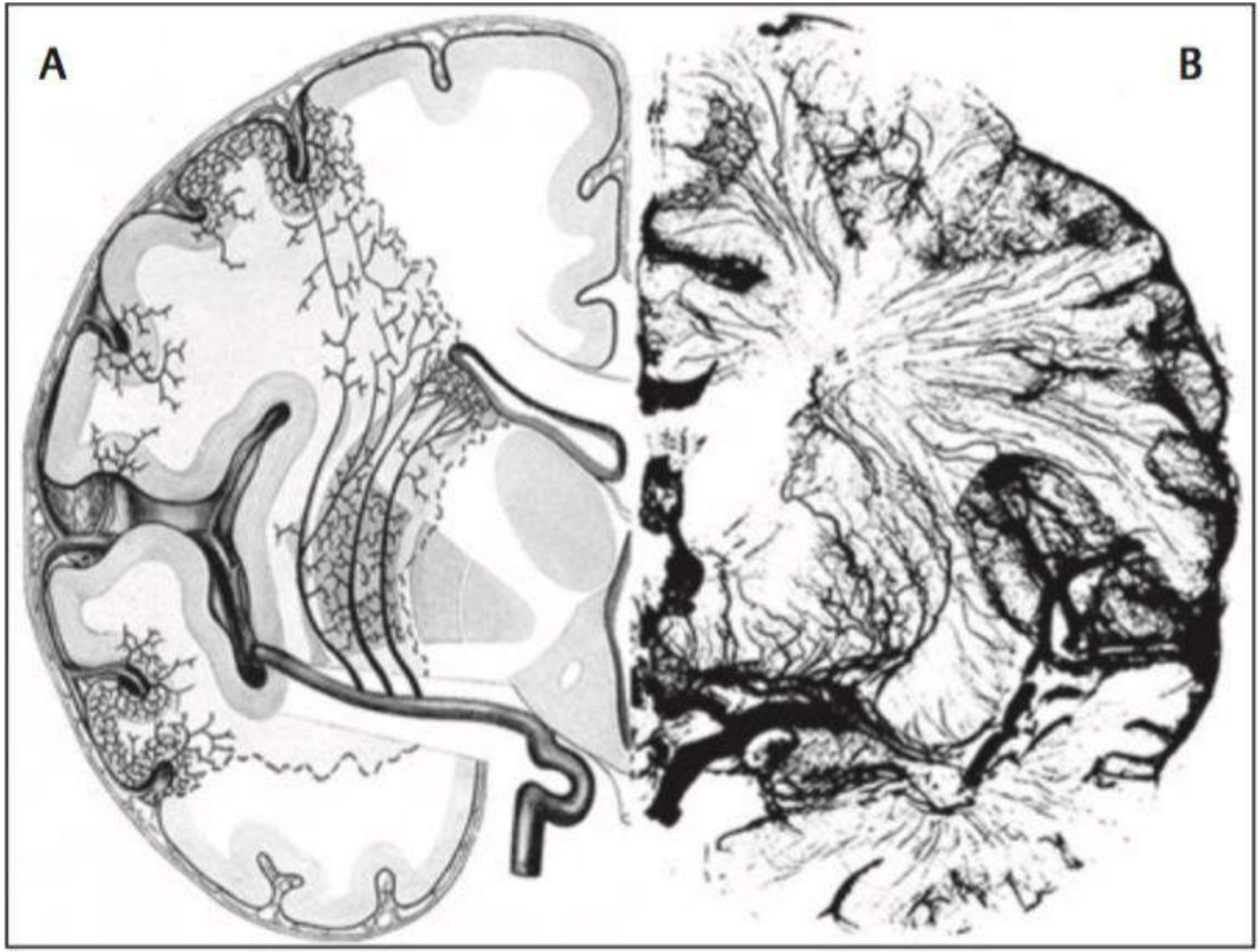
Kotu Kolleteral

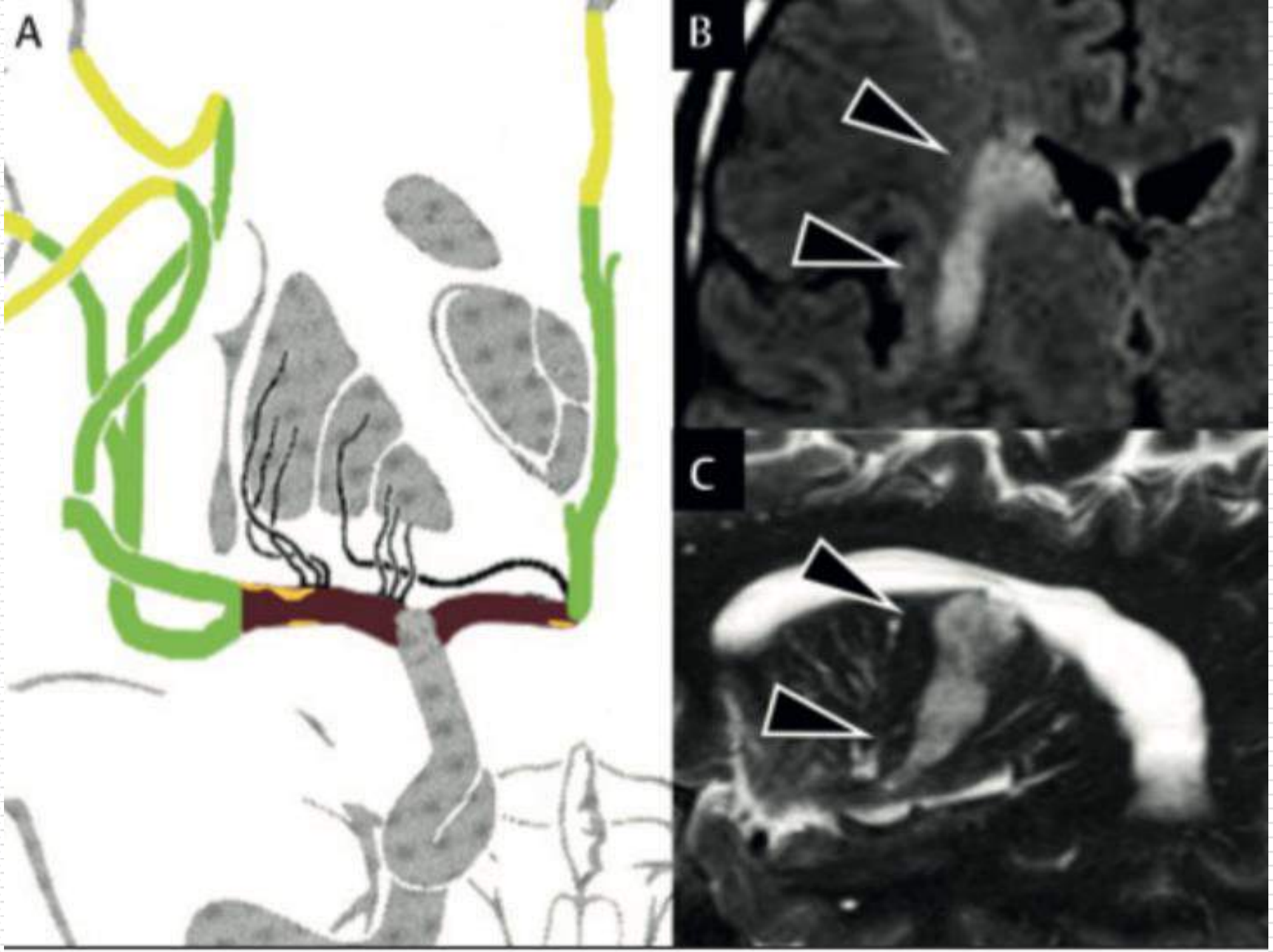



A

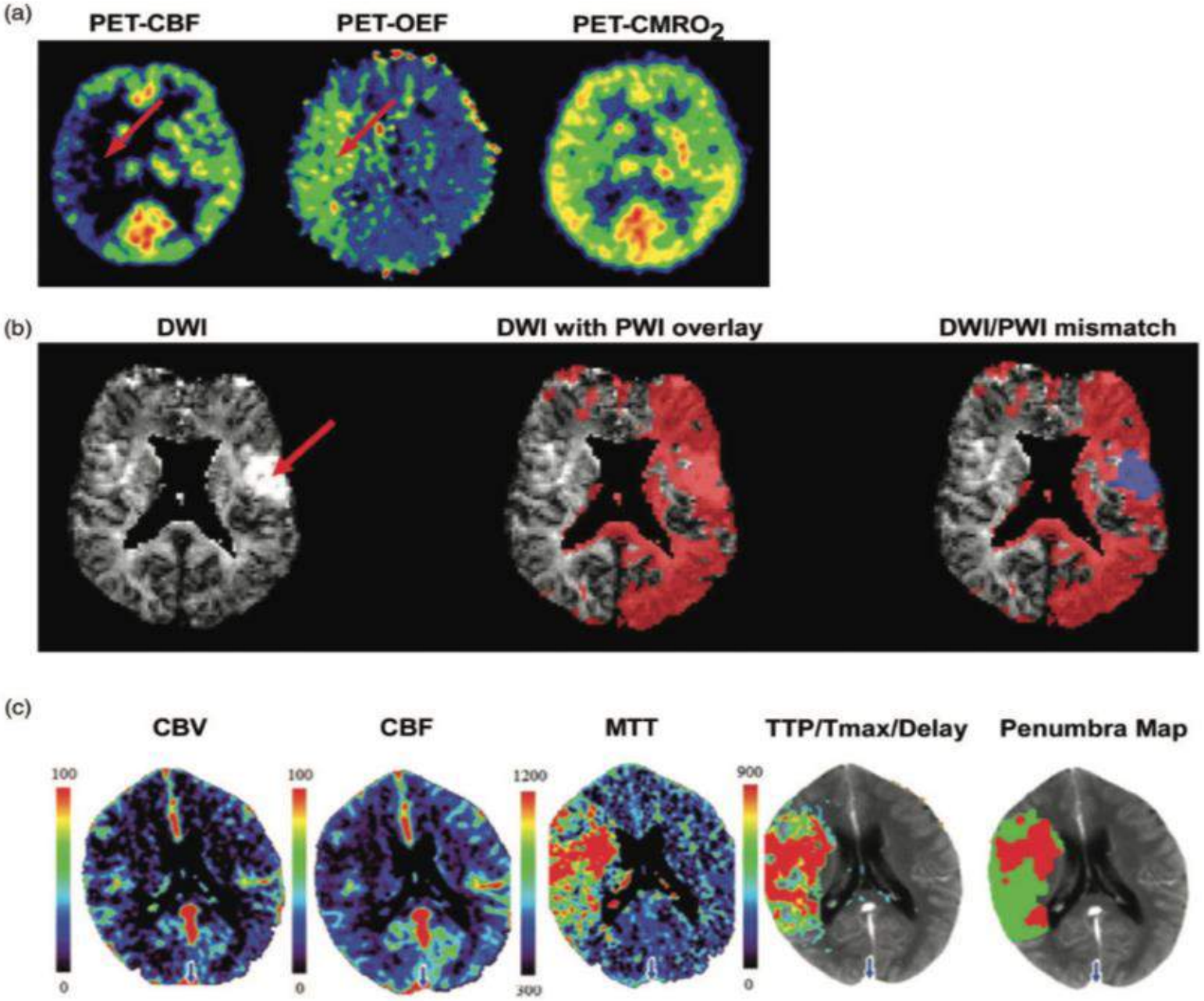

4
9
3
Ulcerated Plaque
Internal Carotid Artery
7
1


C

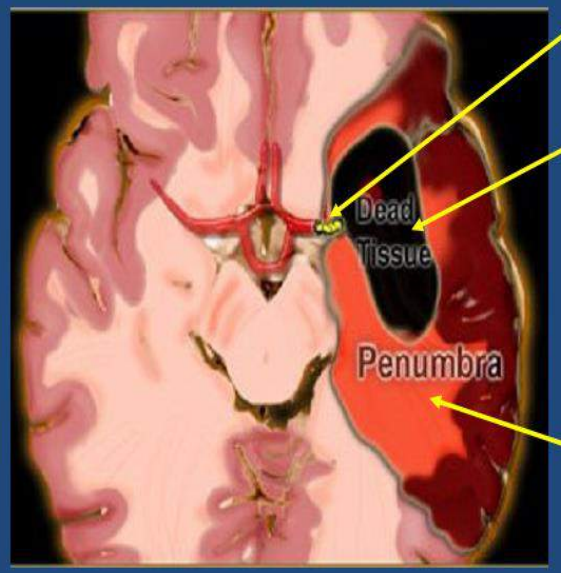

A
B


A
B
C

Techniques	Ischemic core	Ischemic penumbra	Advantages	Disadvantages
PET	Very low CBF[a] and $CMRO_2$ and variable OEF	CBF <20 ml/100 g/min, increased OEF, but relatively preserved $CMRO_2$	Accuracy thanks to quantitative measures of both perfusion and metabolism	Technically challenging Expensive Radiation Limited availability
SPECT	>70% reduction in tracer signal compared to the contralateral side	40–70% reduction of tracer signal compared to contralateral side	Lower cost Good availability	Use of radioactive agents Difficult data analysis Coarse spatial resolution Inaccurate in case of partial reperfusion
MRI: *"Perfusion–diffusion mismatch"*	DWI lesion = hyperintensity	PWI lesion (Tmax > 6 s or delay time > 3 s) – DWI lesion *(MTT less precise than delay measures)*	Most accurate way to map the penumbra and core in the clinical setting	Limited access to MRI Contraindications (e.g. pacemakers, claustrophobia)
MRI: *"ASL–DWI mismatch"*	DWI lesion	ASL–CBF threshold of 40%—DWI lesion	Rapid Non-invasive Quantitative measures	Poor spatial resolution Loss of signal due to low perfusion Artifacts due to slow collateral flow
CTP	Low CBF (<30%)	Tmax > 6 s or delay time- > 3 s *(MTT less precise than delay measures)*	Low cost Good availability	Less reliable than MRI Radiation exposure Artifacts in case of low cardiac ejection fraction


(a)
PET-CBF
PET-OEF
PET-CMRO2
(b)
DWI
DWI with PWI overlay
DWI/PWI mismatch
(c)
CBV
CBF
MTT
TTP/Tmax/Delay
Penumbra Map
100
0
100
0
1200
500
900
0

Infarct Core and Penumbra

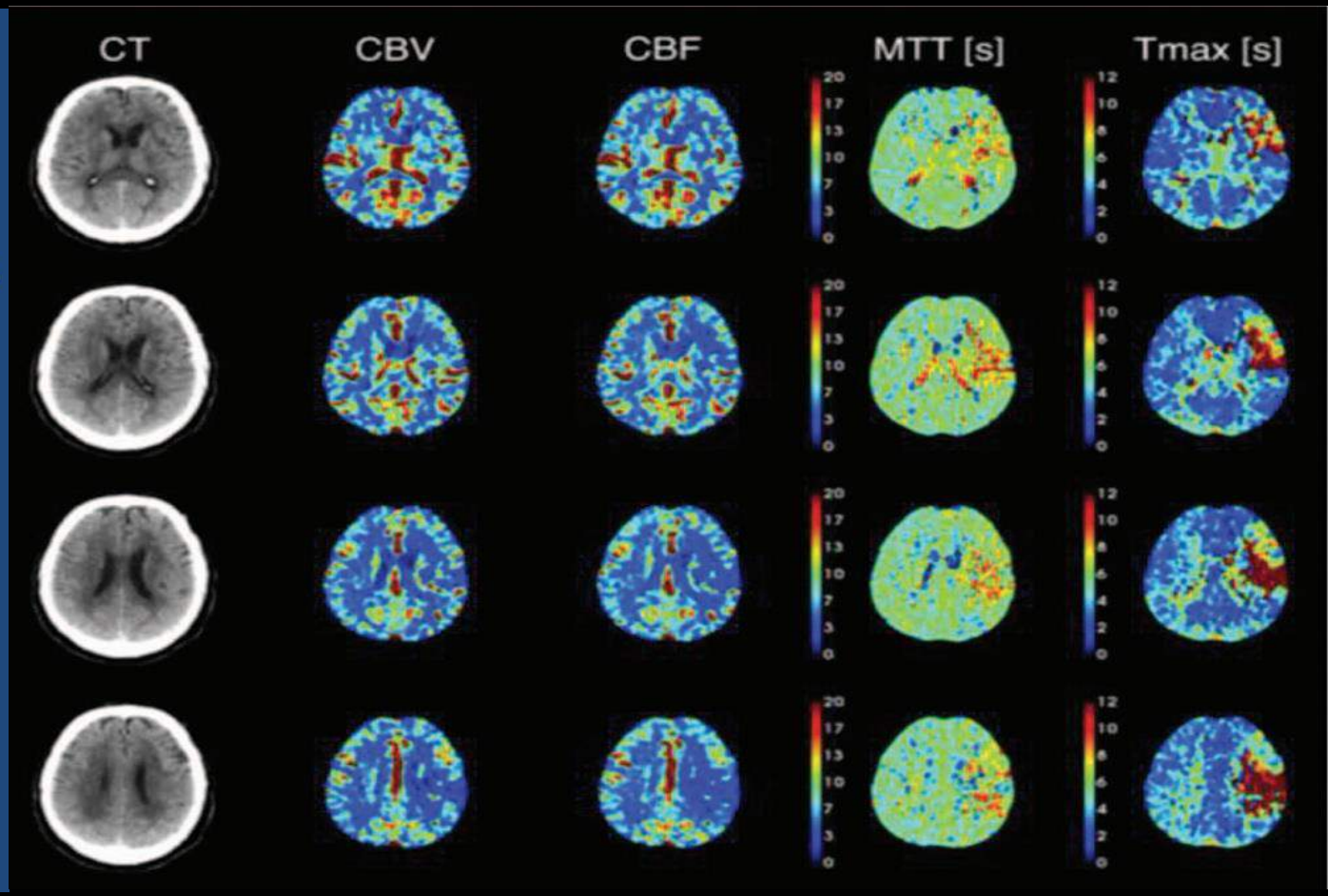


Occluded MCA

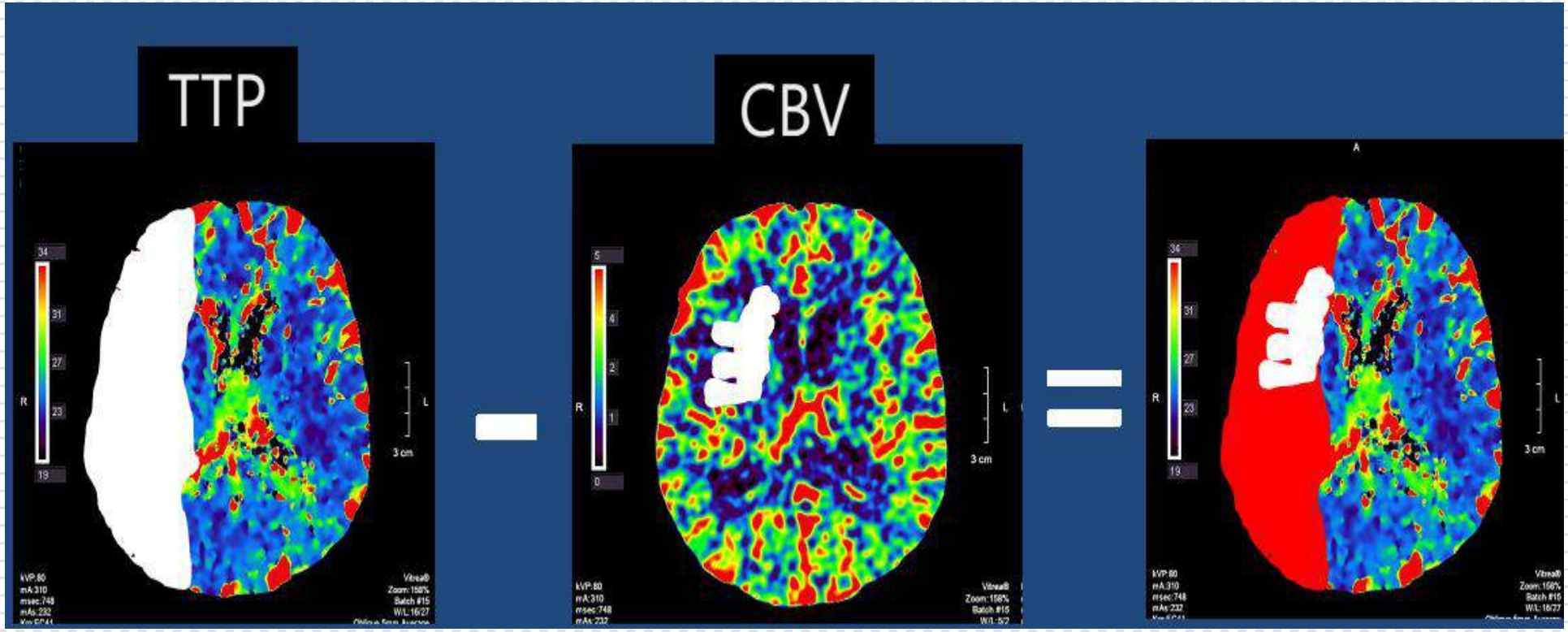
Infarct Core – irreversible damage

Penumbra – tissue at risk

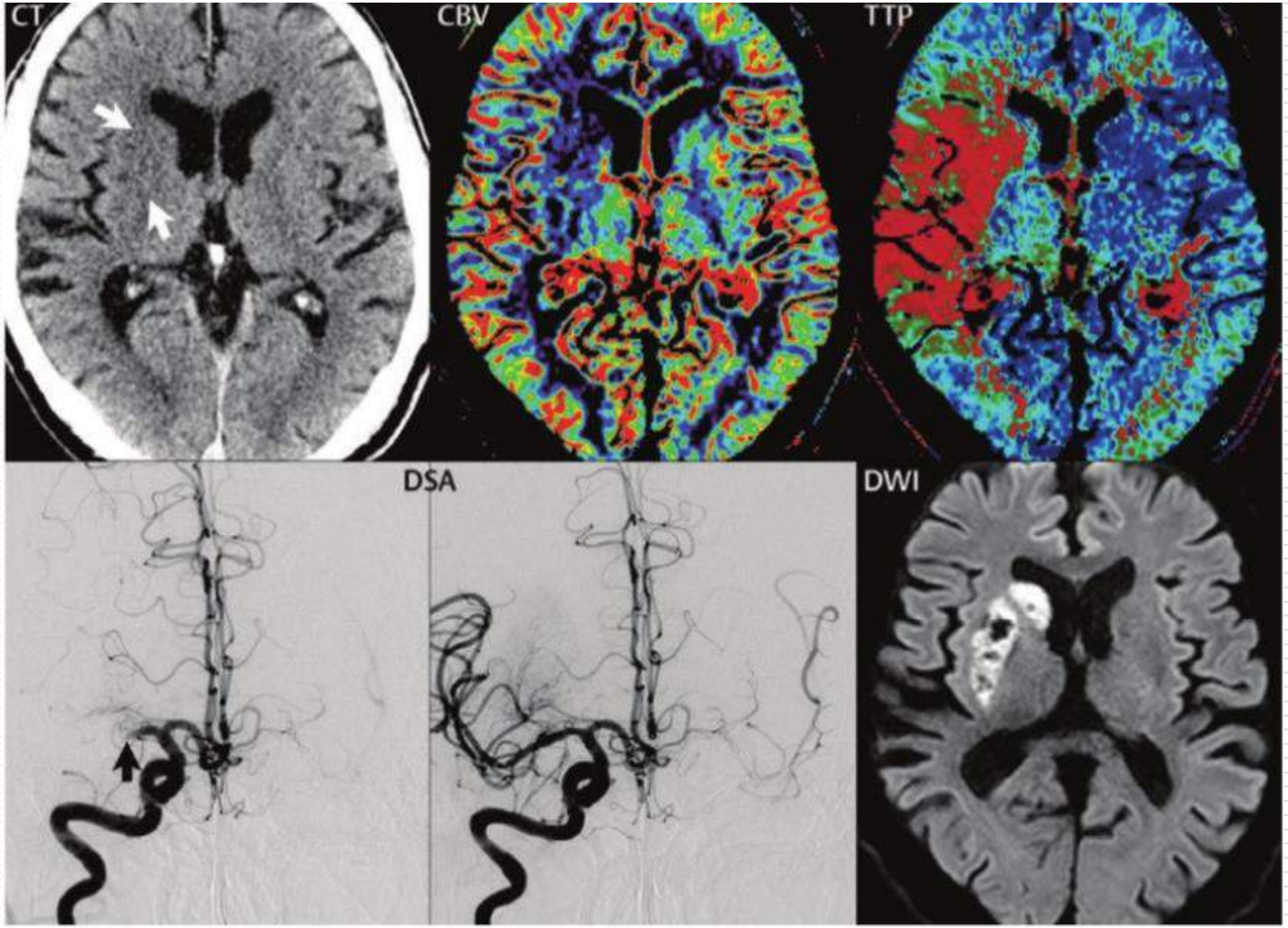
Without treatment the infarction will expand to include penumbra

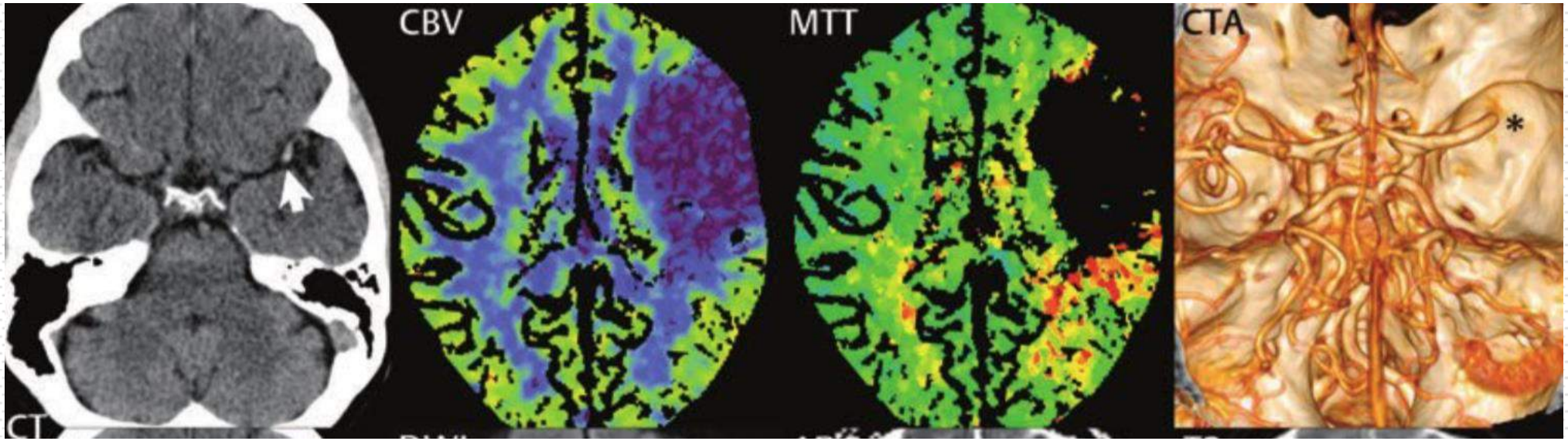


Perfussion Imaging



Penumbra

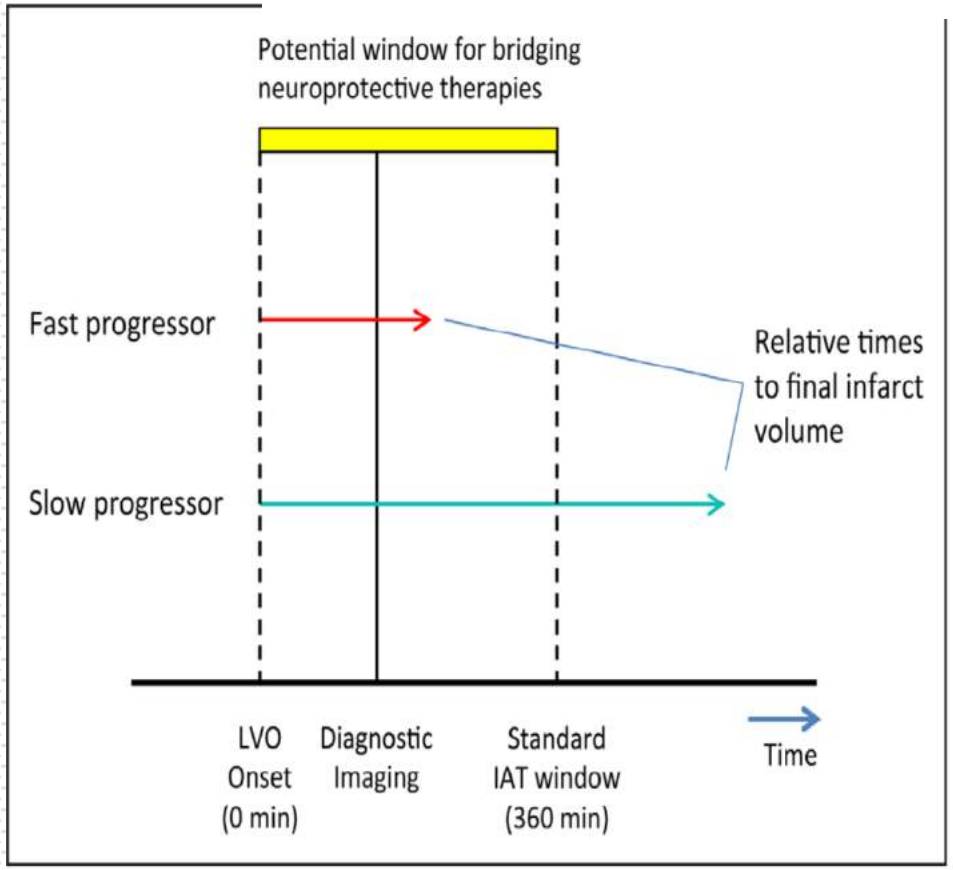

CT
CBV
TTP
DSA
DWI


CBV
MTT
CTA
*

Fast Versus Slow Progressors of Infarct Growth in Large Vessel Occlusion Stroke

Clinical and Research Implications

Marcelo Rocha, MD, PhD; Tudor G. Jovin, MD



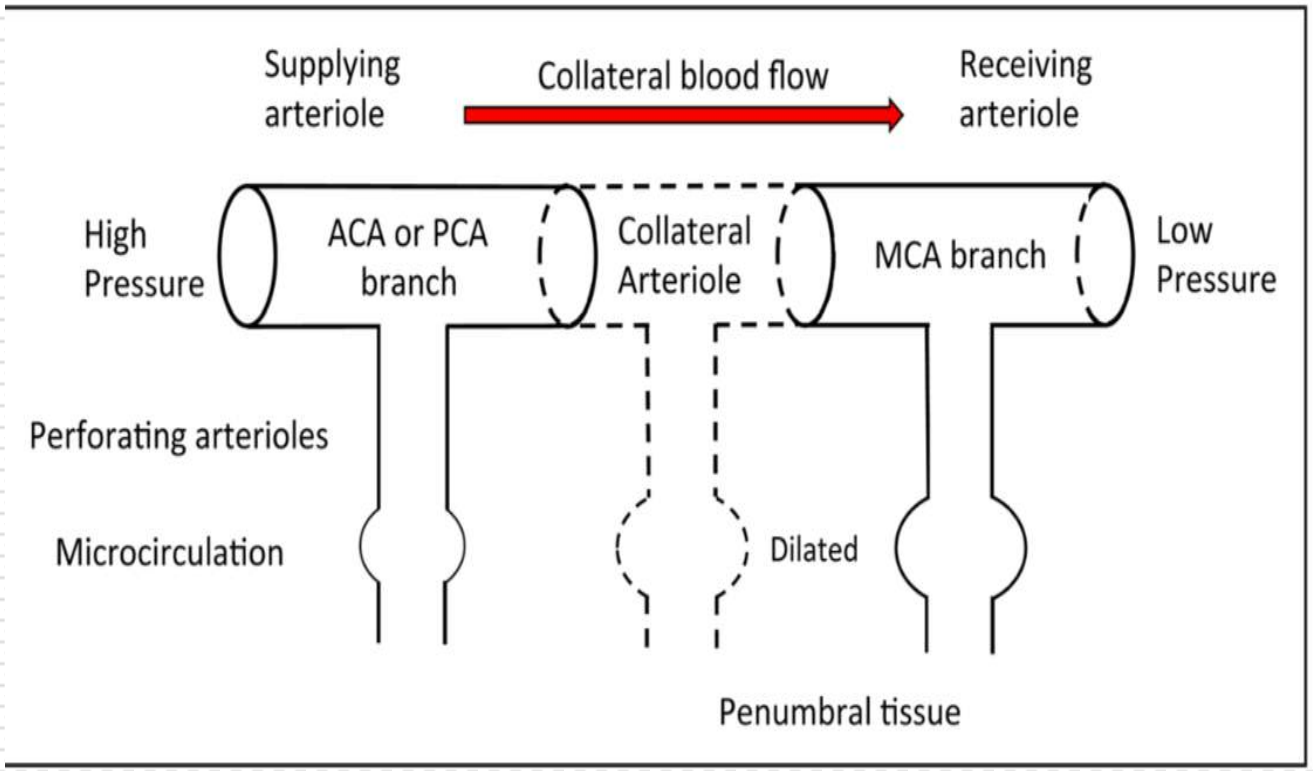
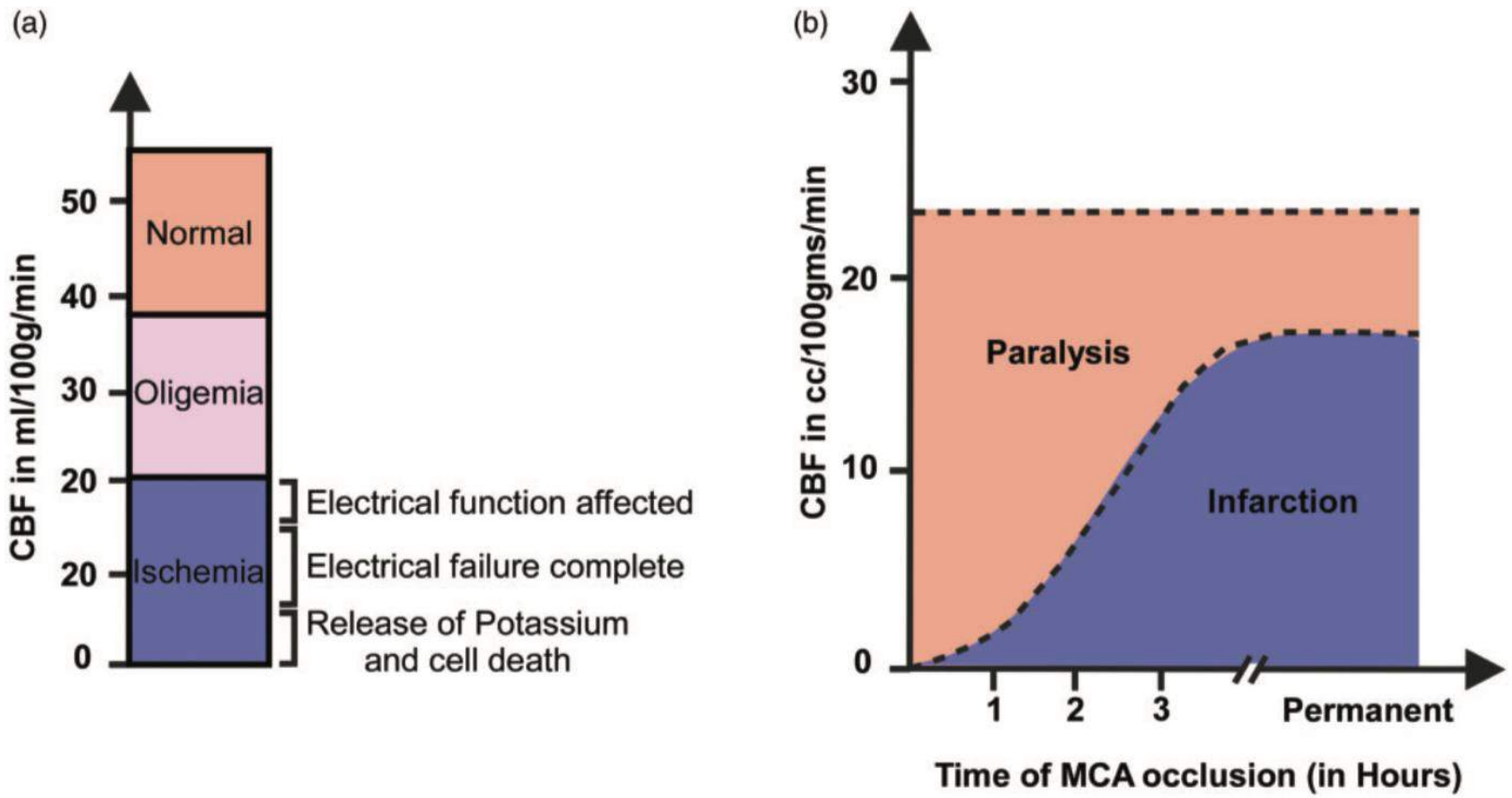


Figure 1. Representation of the ischaemic thresholds from two studies: (a) Figure modified from Astrup *et al.* (1977), represents ischaemic thresholds for electrical failure and K+ release. (b) Cartoon modified from Jones *et al.* (1981), illustrating the CBF x Time interaction, where paralysis represents the ischaemic penumbra and infarction representing the core.
Source: reproduced with permission from Astrup et al., 1977[4] and Jones et al., 1981.[7]

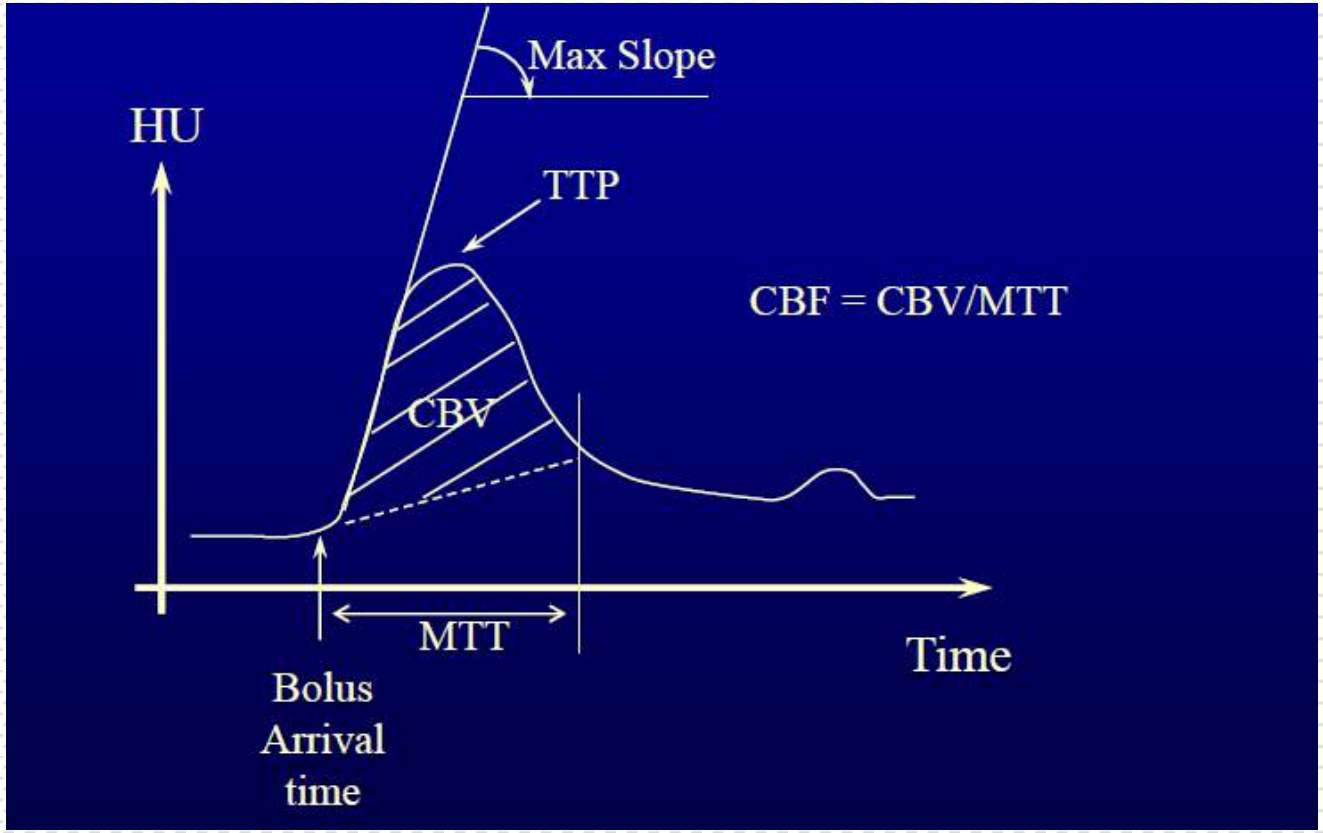


Penumbra
Reversible Perfusion Deficit

Otoregülator mekanizma intakt

Vasodilatasyon mevcut

Serebrovasküler reserv kapasite düşük (CVR)



MTT
(Deconvolution)

↓

CBV

CBF=
CBV/MTT

MTT mean transit time (sn): arteriyel input ile venöz output arasındaki zaman

TTP time to peak (sn): kontrastın maksimum değerine ulaşıncaya kadar geçen zaman

CBV cerebral blood volume (ml/100 g): birim miktardaki beyin parankimindeki kan volümü

CBF cerebral blood flow (ml/100 g/min): birim miktardaki beyin parankiminden dakikada geçen kan volümü

Beyin perfusion	**Cerebral blood flow**
Normal	>50–60 ml/100 g/min
Oligemi	30–60 ml/100 g/min
Penumbra	20–30 ml/100 g/min
İnfarkt	< 10 ml/100 g/min

Gri Cevher CBV ~ 4 mL/100 g/min,
Beyaz Cevher CBV ~ 2 mL/100 g/min

Gri Cevher CBF ~ 40–60 mL/100 g/min,
Beyaz Cevher CBF ~ 20–30 mL/100 g/min

CBF = CBV/MTT

Normal perfüzyon parametreleri

Gri cevher

MTT: 4 s

CBF: 60 ml/100 g/min

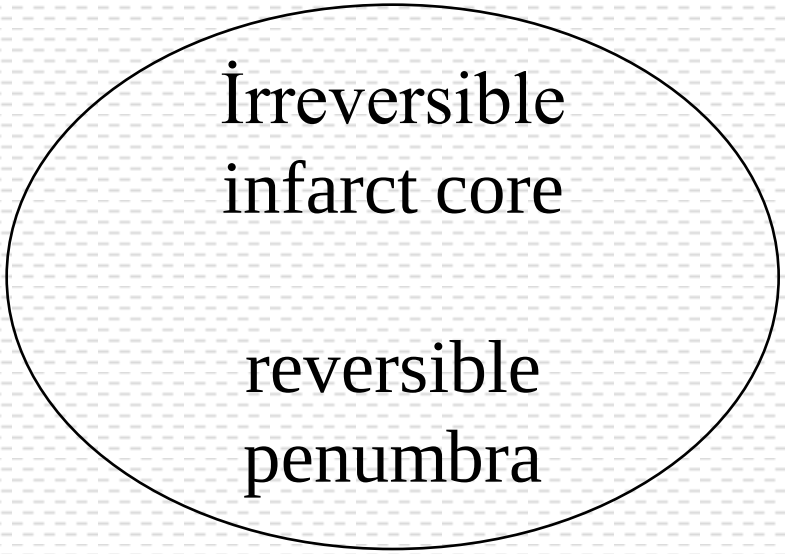
CBV: 4 ml/100 g

Beyaz cevher

MTT: 4.8 s

CBF: 25 ml/100 g/min

CBV: 2 ml/100 g



İNFARKT

CBF < 25 mL ×100 g^{-1}× min^{-1}.

CBV < 2 mL ×100 g^{-1}

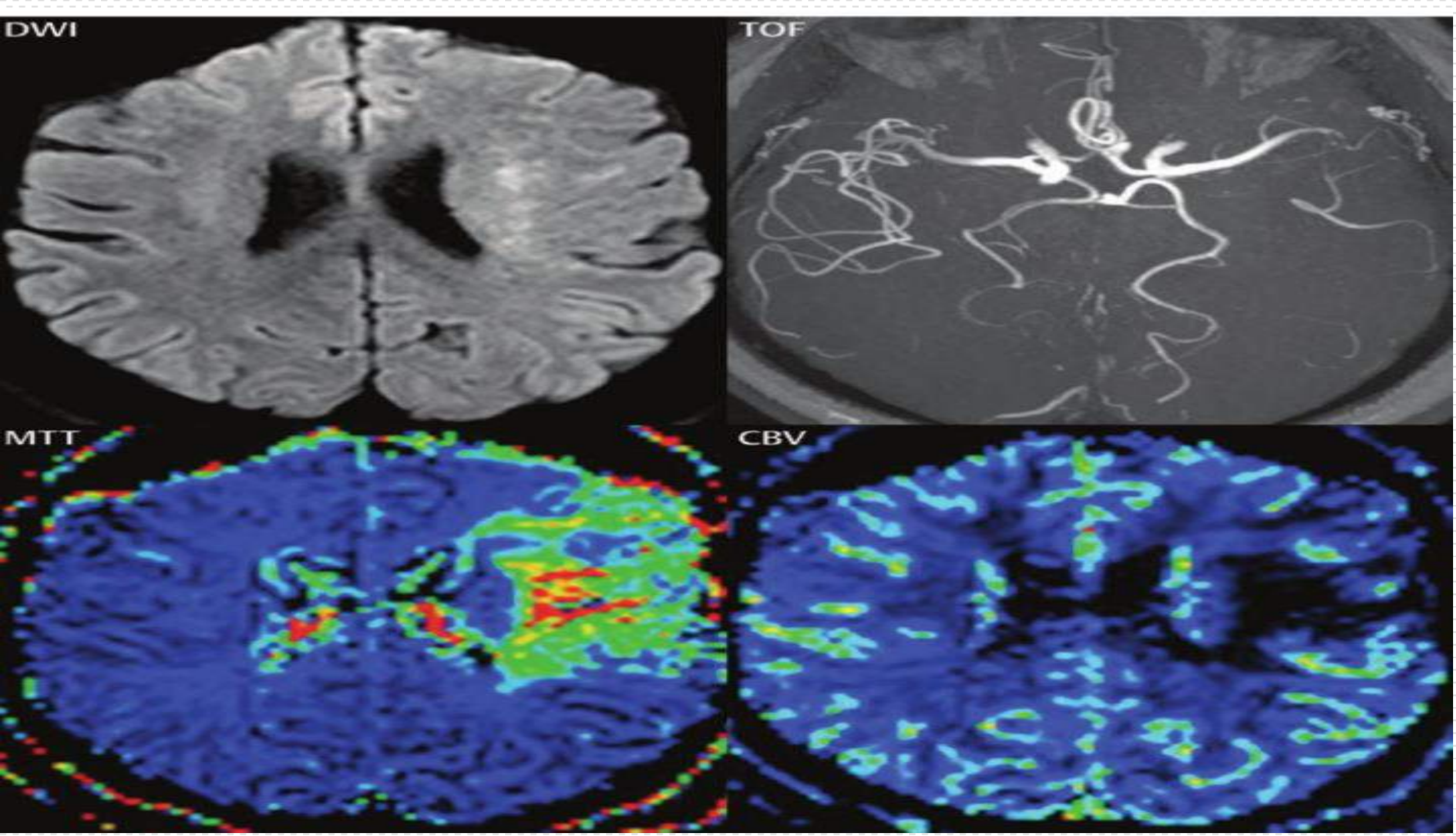
PENUMBRA

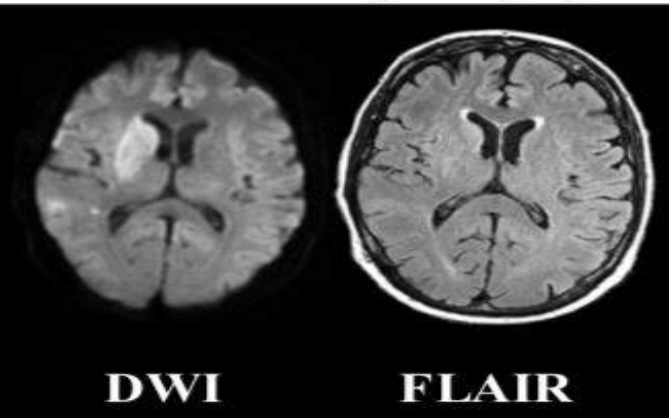
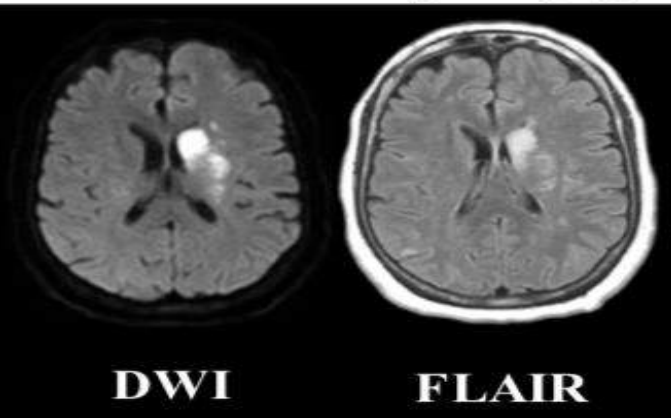
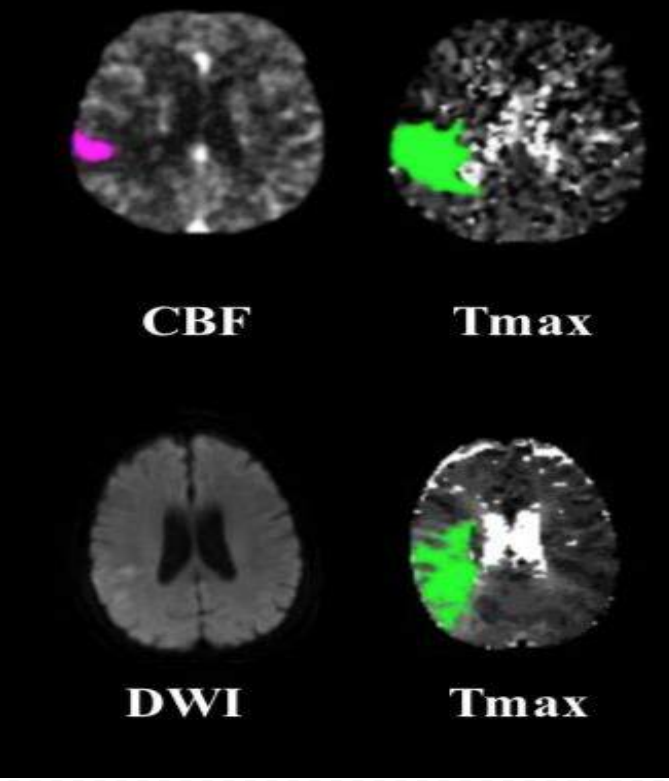
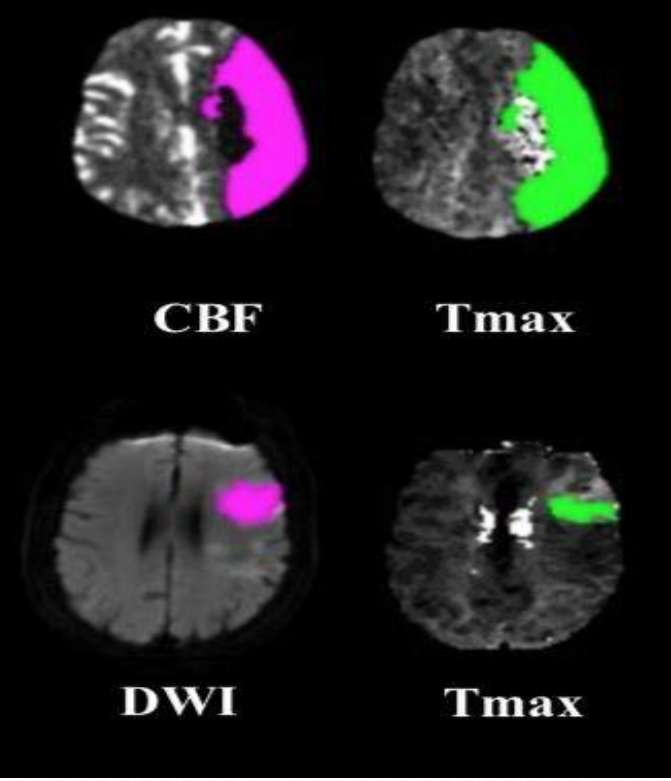
Artmış MTT (>6.4 sn)
>60% CBF
Normal yada artmış CBV (80%–100% veya daha yüksek) (2-2.2 ml/100 mg)

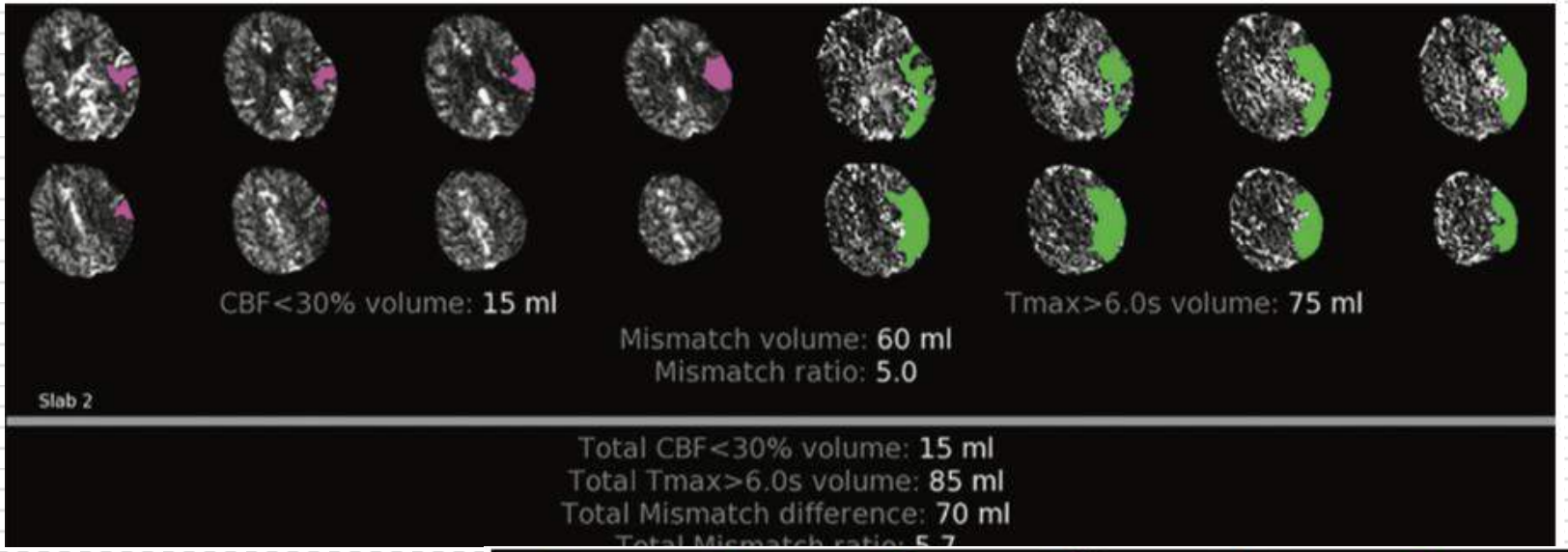
Artmış MTT (>6.4 sn)
>30% CBF
>60% CBV,

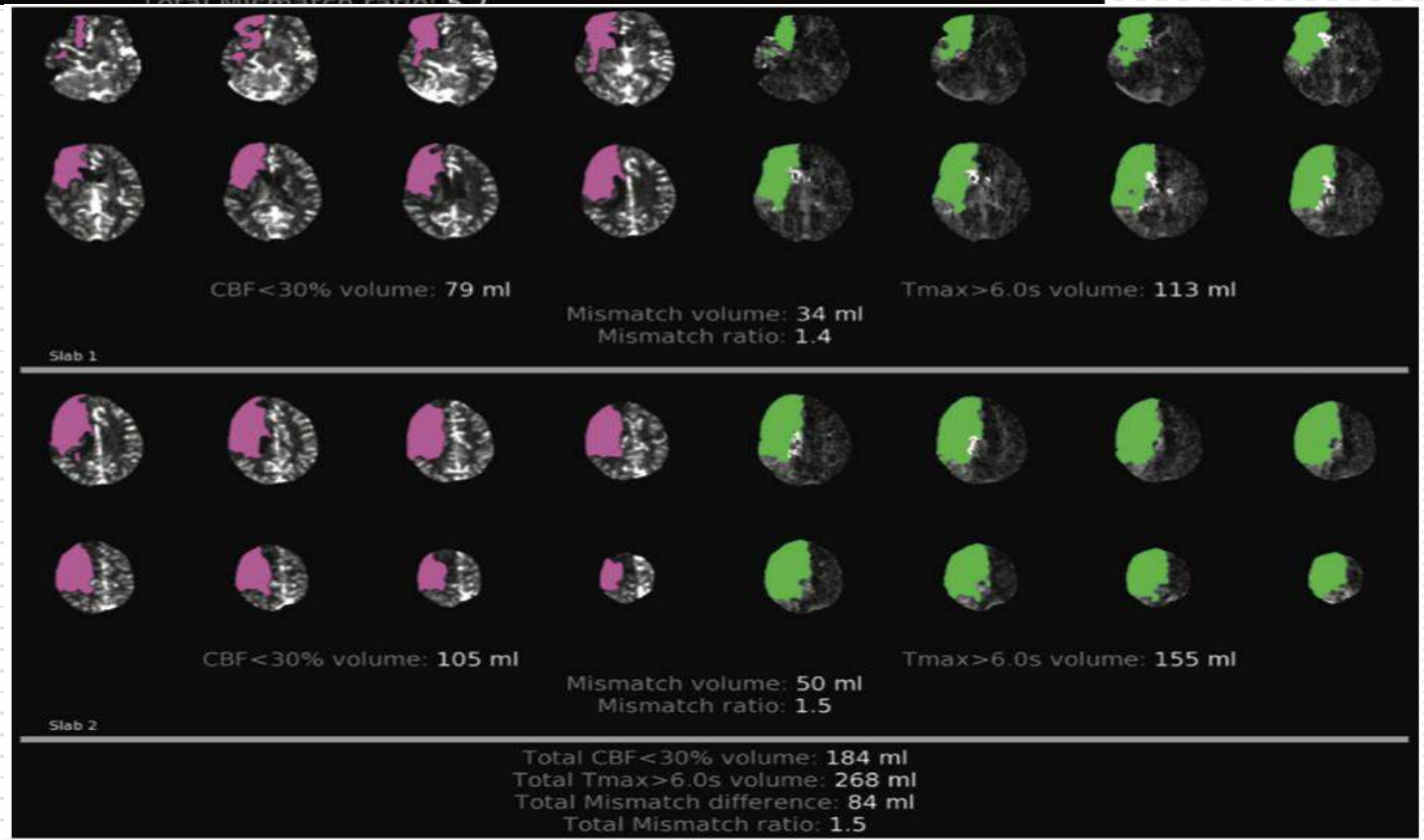
İNFARKT

<30% CBF
<40% CBV
artmış MTT (%145 & 6.4 sn)


DWI
TOF
MTT
CBV

	Clinical Criteria	Advanced Imaging Criteria		Candidate by Imaging	Not a Candidate by Imaging
WAKE-UP	• Age 18-80 • NIHSS < 25 • LKW > 4.5 h	• DWI/FLAIR mismatch • DWI lesion < 1/3 MCA territory.			
EXTEND	• Age > 18 • NIHSS 4-26 • LKW 4.5-9 h	• Penumbra – core mismatch ratio > 1.2 • Penumbra – core absolute difference > 10 ml • Core < 70 ml	**CT** **MRI**		


CBF<30% volume: 15 ml
Tmax>6.0s volume: 75 ml
Mismatch volume: 60 ml
Mismatch ratio: 5.0
Slab 2
Total CBF<30% volume: 15 ml
Total Tmax>6.0s volume: 85 ml
Total Mismatch difference: 70 ml


CBF<30% volume: 79 ml
Tmax>6.0s volume: 113 ml
Mismatch volume: 34 ml
Mismatch ratio: 1.4
Slab 1
CBF<30% volume: 105 ml
Tmax>6.0s volume: 155 ml
Mismatch volume: 50 ml
Mismatch ratio: 1.5
Slab 2
Total CBF<30% volume: 184 ml
Total Tmax>6.0s volume: 268 ml
Total Mismatch difference: 84 ml
Total Mismatch ratio: 1.5

DAWN Trial

- Infarkt alani < 1/3 MCA territory (CT veya MRI)
- MRA veya BTA da MCA M1 veya terminal ICA okluzyonu
- Klinik Imaging Mismatch (CIM) RAPID Software
- DWI veya CTP-rCBF maps:
  a. 0-20 cc kor infarkt ve NIHSS ≥ 10 (yas ≥ 80)
  b. 0-30 cc kor infarkt ve NIHSS ≥ 10 (yas < 80)
  c. 31 cc -< 50 cc kor infarkt ve NIHSS ≥ 20 (yas< 80)

DEFUSE 3 Trial

Inclusion criteria	DEFUSE-3[10]
Time window	6–16 hours since tim last known well
Age	18–90 years
mRS score before qualifying stroke	≤2; life expectancy ≥6 mont
NIHSS score	≥6
Arterial occlusion	ICA and/or M1 *
Mismatch definition	Target mismatch pro on CT or MR perfusi imaging, as determi by an automated im postprocessing syste Infarct core volume <70 mL† AND mismatch volume >15 mL (Tmax>6 s‡) AND mismatch ratio (penumbra/core) >1.8

*Carotid occlusions could be cervical or intracranial, wi lesions in DEFUSE-3.
†Based on CT perfusion or MRI diffusion.
‡The size of the penumbra was estimated from the volu was delayed arrival of an injected tracer agent (time to

CLEAR Study

- 1604 Hasta
- 5 ülke, 15 merkez
- 6-24 saatte trombektomi yapılan hastalar
- Görüntüleme
  - BT
  - BT perfüzyon
  - MRI
- 1604 hasta değerlendirilmiş 534 hastaya sadece BT ile trombektomi uygulanmış

Nguyen ve ark JAMA 2021

CLEAR Study

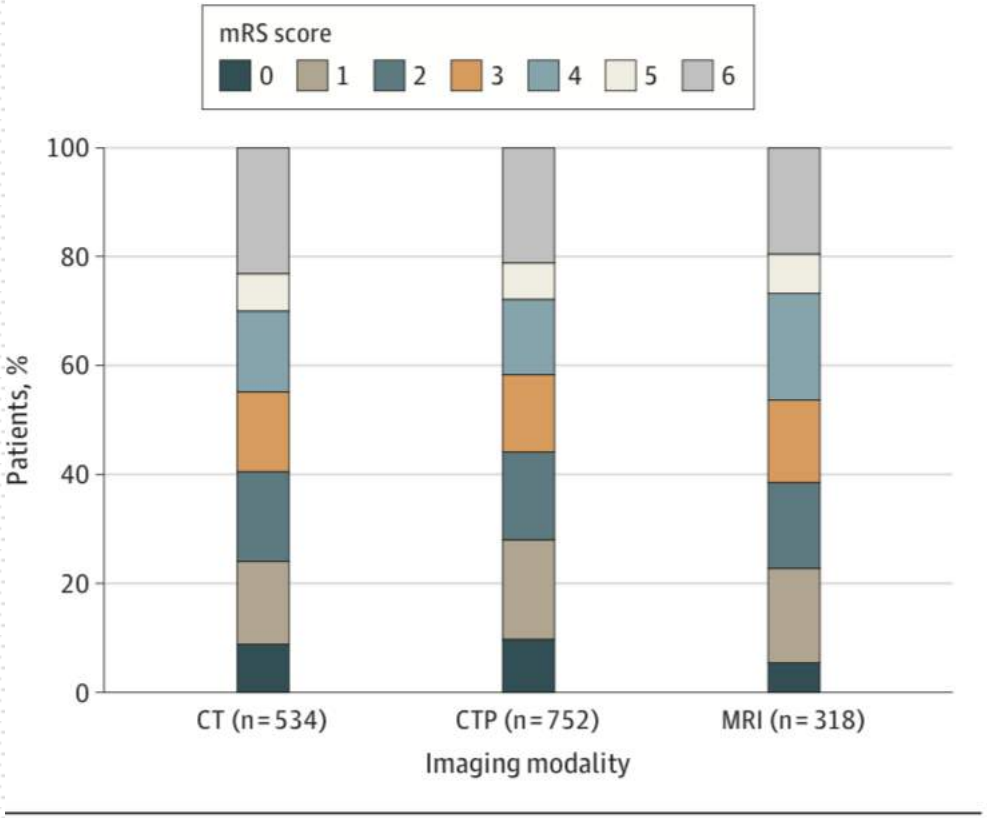


Table 1. Baseline Characteristics, Metrics, and Outcomes of Patients in the 6-24–Hour Window, According to Imaging Modality Selection for Thrombectomy (continued)

Characteristic	Patients, No. (%)				*P* value
	Overall	Computed tomography[a]	Computed tomography perfusion	Magnetic resonance imaging	
90-d mRS score					.21
0-2	676 (42.1)	220 (41.2)	333 (44.3)	123 (38.7)	
3-6	928 (57.9)	314 (58.8)	419 (55.7)	195 (61.3)	
Symptomatic intracranial hemorrhage[b]					.11
No	1478 (93.7)	476 (91.9)	700 (94.2)	302 (95.3)	
Yes	100 (6.3)	42 (8.1)	43 (5.8)	15 (4.7)	
Mortality, 90 d					
No	1258 (78.4)	409 (76.6)	593 (78.9)	256 (80.5)	.38
Yes	346 (21.6)	125 (23.4)	159 (21.1)	62 (19.5)	

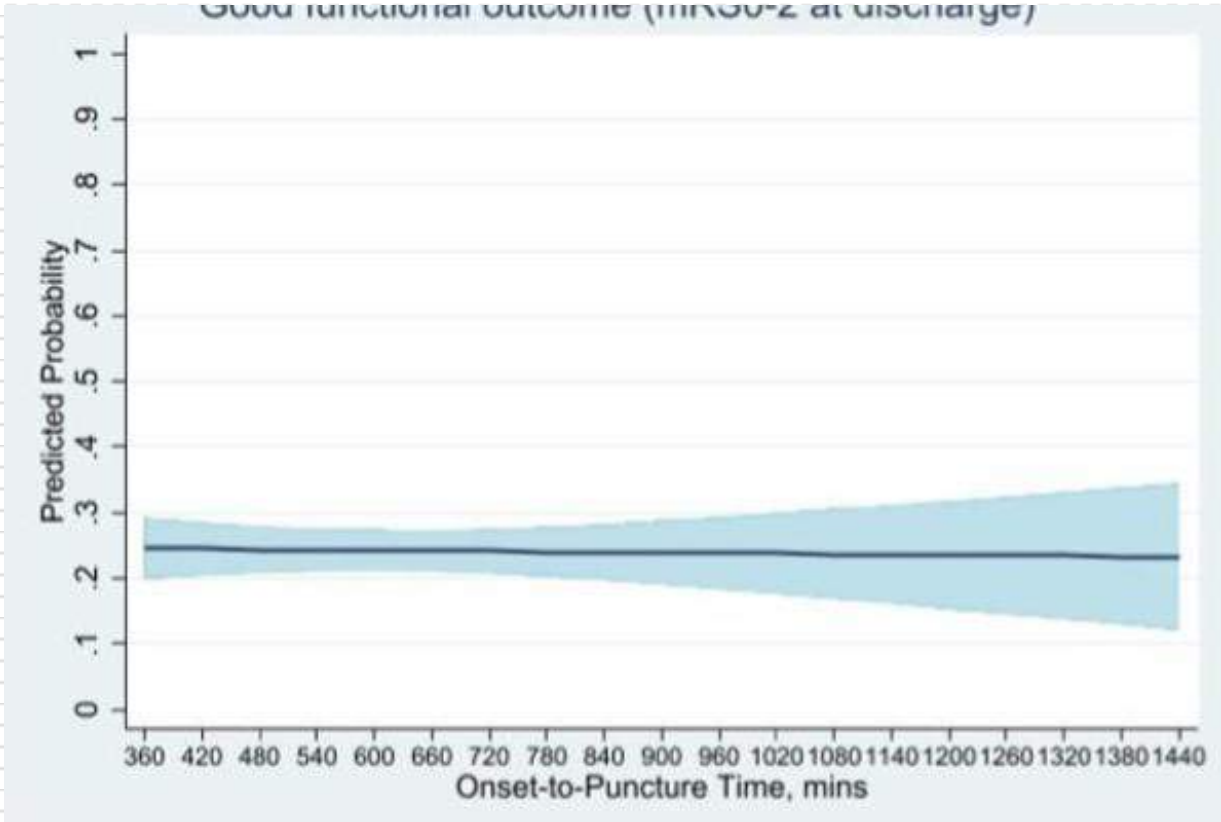
Association between Time to Treatment and Clinical Outcomes in Endovascular Thrombectomy Beyond 6 hours Without Advanced Imaging Selection

- 3278 hasta, 2610 (79.6%) ilk 6 saat ve 668(20.4%) hasta 6-24 saat
- Sadece BT ve BT angio ile seçilen hastalar
- 5 yillik sure Ingiliz Ulusal Registry

Dhillon ve ark J Neurointerv Surg 2022

Feature	< 6 hours n (%) median (IQR) or mean±SD	6 – 24 hours n (%) median (IQR) or mean±SD	P value
Socio-demographics			
Sample size	2610	668	
Sex (male)	1450 (55.3)	366 (54.8)	0.81
<60 years	646 (24.8)	220 (32.9)	**<0.001**
60-69	534 (20.5)	128 (19.2)	
70-79	785 (30.1)	177 (26.5)	
80-89	573 (21.9)	130 (19.5)	
>90 years	72 (2.8)	13 (1.9)	
Baseline characteristics			
NIHSS on admission	18(13-22)	16(9-20)	**<0.001**
Rankin before Stroke	0(0-1)	0(0-1)	0.06
IV Thrombolysis	1835 (70.3)	226 (33.8)	**<0.001**
Witnessed Stroke Onset	1742 (66.7)	454 (67.9)	0.54
General Anesthesia	1345 (51.5)	411 (61.5)	**<0.001**
ThromboAspiration	1861 (71.3)	480 (71.2)	0.77
StentRetriever	1405 (53.8)	412 (61.9)	**<0.001**
ThromboAspiration & StentRetriever	969 (37.1)	300 (44.9)	**<0.001**
Proximal Balloon Flow Arrest	477 (18.3)	139 (20.8)	0.13

me measures	Onset To Puncture Early Window (<6 hours) n/N (%)	Onset To Puncture Late Window (6-24 hours) n/N (%)	Early vs Late Window	
			aOR (95% CI)**	P val
charge (Ordinal)	N=2610	N=668	0.65 (0.55 – 0.77)	**0.000**
	521/2610 (19.9)	98/668 (14.6)	0.58 (0.44 – 0.76)	**0.000**
	879/2610 (33.6)	166/668 (24.8)	0.56 (0.45 – 0.70)	**0.000**
nonths (Ordinal) ∂	N=725	N=207	0.66 (0.49 – 0.90)	**0.00**
	439/725 (60.5)	112/207 (54.1)	0.67 (0.47 – 0.97)	**0.03**
	2113/2610 (80.9)	523/668 (78.3)	0.82 (0.65 – 1.03)	0.0
	1284/2610 (49.2)	324/668 (48.5)	0.95 (0.79 – 1.14)	0.5
nalization	1372/2610 (52.5)	436/668 (65.2)	1.84 (1.50 – 2.25)	**0.000**
	1596/2497 (63.9)	335/632 (53.0)	0.73 (0.60 – 0.89)	**0.00**
	221/2497 (8.8)	105/632 (16.6)	1.70 (1.28 – 2.25)	**0.000**
	281/1781 (15.7)	74/503 (14.7)	1.02 (0.76 – 1.37)	0.8
	58/1665 (3.4)	20/431 (4.6)	1.19 (0.67 – 2.09)	0.5
Mortality	338/2610 (12.9)	98/668 (14.6)	1.14 (0.87 – 1.49)	0.3



Ilginiz için tesekkurler

6 saat Sonrası İnme ve Uyanma İnmeleri: Vaka Seçimi

Dr. Vedat Ali YÜREKLİ

Süleyman Demirel Üniversitesi Tıp Fakültesi Nöroloji Ana Bilim Dalı

IV. Girişimsel Nöroloji Eğitim Toplantısı
21 - 22 MAYIS 2022
SHIMALL DELUXE OTEL, GAZİANTEP

- Uyanma inmeleri ve 6 saat sonrası başvuran akut inmeler, tüm inmelerin %14-27'sini oluşturur.

G. Thomalla et al. N Engl J Med 379;7 nejm.org August 16, 2018

- DAWN ve DEFUSE-3 çalışmaları geç başvuran anterior sistem büyük damar oklüzyonlarına bağlı akut iskemik inmelerde endovasküler trombektominin etkinliğini göstermiştir

Nogueira RG, DAWN Trial Investigators Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct. N Engl J Med 2018;378:11-21.

- Son randomize kontrollü çalışmalar, akut iskemik inmede
  - hem IVT
  - hem de EVT için

  terapötik zaman penceresini genişletti,

  Ancak;

  aynı zamanda tedavi algoritması karmaşıklığını da artırdı

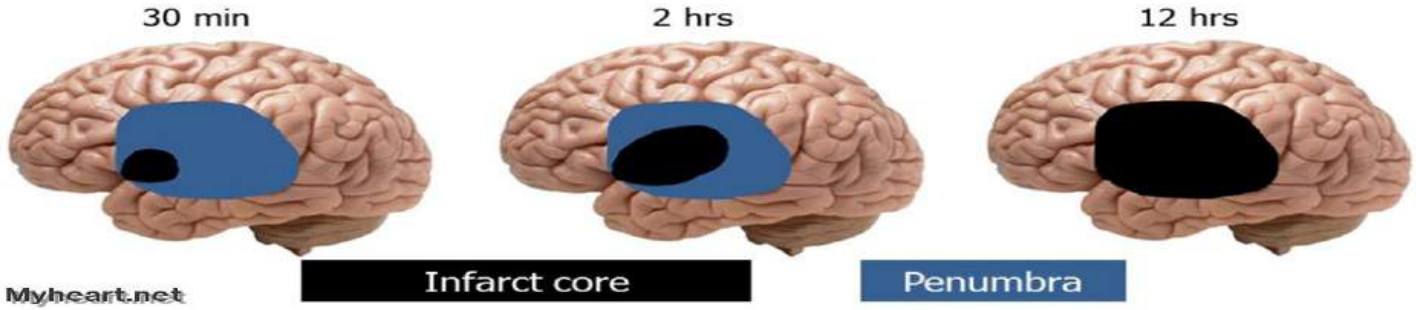
- Bu çalışmalarla artık "zaman temelli" hasta seçimi, yerini "doku temelli" hasta seçimine bırakmıştır.

- Büyük damar tıkanıklıklarına bağlı akut iskemik inmeli hastalarda;
  - rekanalizasyonda 30 dakikalık gecikme,
  - iyi klinik sonlanım olasılığında %16'lık bir azalmaya yol açar.

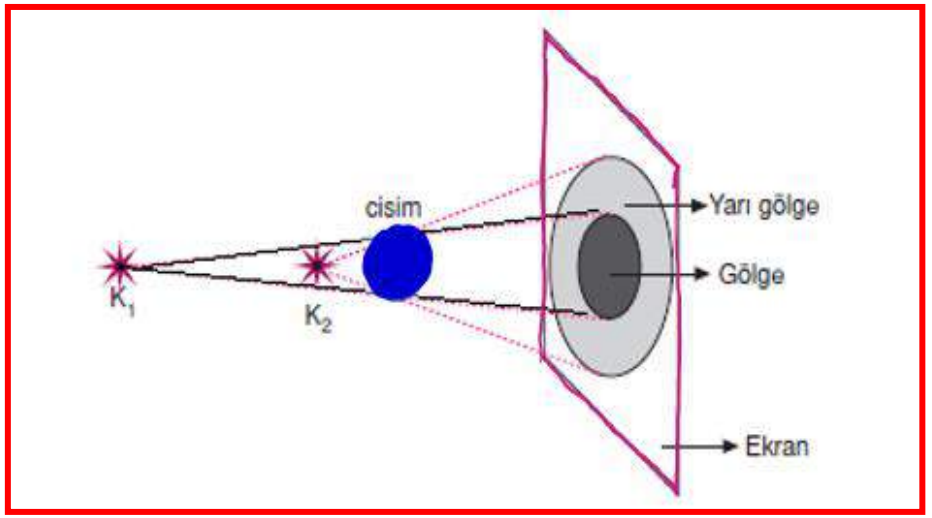
Tsivgoulis G, Saqqur M, Sharma VK, *et al.*; CLOTBUSTPRO Investigators. Timing of recanalization and functional recovery in acute ischemic stroke. *J Stroke* 2020; 22: 130–140

- Geç başvuran inmelerle birlikte uyanma inme hastalarında aslında reperfüzyon tedavilerine uygun olabilecek bir çok hasta grubu bulunabilmektedir.

- DAWN ve DEFUSE-3 çalışmalarında;
- Gerek dahil edilme kriterlerinin karışık olması
- Gerekse hasta seçimi için kullanılan yazılımların her merkezde bulunmaması,
  - hasta seçimi ile ilgili yeni çalışmalar gerektiğini ortaya koymaktadır.



- Nöro-görüntülemede önemli olan kısım, küçük bir iskemik çekirdeğe ve büyük bir penumbraya sahip hastayı yakalayabilmektir.



- Büyük olasılıkla bu hastalar hızlı hareket edilirse reperfüzyon tedavilerinden fayda görecektir.

Umbra; tam gölge

Penumbra; yarı gölge

TABLO 1: DAWN ve DEFUSE-3 çalışmalarının ana metodolojik karakteristikleri.

DAWN	DEFUSE-3
Son normal görülme zamanına göre 6-24 saat	Son normal görülme zamanına göre 6-16 saat
Intrakraniyel IKA veya proksimal OSA oklüzyonu	Ekstrakranial veya İntrakranial IKA veya proksimal OSA oklüzyonu
Grup A: >80 yaş, NIHSS >10; enfarkt hacmi <21 ml Grup B: <80 yaş, NIHSS >10; enfarkt hacmi <31 ml Grup C: <80 yaş, NIHSS >20; enfarkt hacmi 31-51 ml	Enfarkt hacmi <70 ml ve iskemik doku hacminin başlangıç enfarkt hacmine oranı >1.8
BT veya MR temelli görütüleme	BT veya MR temelli görütüleme
RAPID yazılım (Görüntü analizi için)	RAPID yazılım (Görüntü analizi için)
Sadece TREVO cihazı kullanılmıştır	Tüm FDA onaylı Trombektomi cihazlarına izin verilmiştir

Enfarkt hacminin hesaplanması diffüzyon ağırlıklı MR görüntüleme veya perfüzyon BT ile alınan görüntülerin otomatize yazılım (RAPID, iSchemaView) yardımı ile yapılmıştır.

Gürkaş E. Uyanma inmeleri ve 6 saat sonrası başvuran akut inmelerde endovasküler tedavi. Müngen B, Özdemir AÖ, editörler. Akut İskemik İnmede Endovasküler Revaskülarizasyon. 1. Baskı. Ankara: Türkiye Klinikleri; 2019. p.7-10.

3.7. Mechanical Thrombectomy (Continued)	COR	LOE	New, Revised, or Unchanged
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	New recommendation.
8. In selected patients with AIS within 16 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	New recommendation.

- Bu çalışmalar sonucunda, AHA/ASA 2018 kılavuzu 6-16 saat dilimi içerisinde yer alan ve DAWN ve/veya DEFUSE 3 çalışma kriterlerini sağlayan hastalarda trombektomiyi Klas 1A

- 16-24 saat dilimi içerisinde yer alan ve DAWN çalışma kriterlerini sağlayan hastalar için de Klas 2A olarak önerileri arasına almıştır

3.7. Mechanical Thrombectomy (Continued)	COR	LOE	New, Revised, or Unchanged
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	New recommendation.
8. In selected patients with AIS within 16 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	New recommendation.

The DAWN trial used clinical imaging mismatch (a combination of NIHSS score and imaging findings on CTP or DW-MRI) as eligibility criteria to select patients with large anterior circulation vessel occlusion for treatment with mechanical thrombectomy between 6 and 24 hours from last known normal. This trial demonstrated an overall benefit in function outcome at 90 days in the treatment group (mRS score 0–2, 49% versus 13%; adjusted difference, 33%; 95% CI, 21–44; posterior probability of superiority >0.999).[108] In DAWN, there were few strokes with witnessed onset (12%).The DEFUSE 3 trial used perfusion-core mismatch and maximum core size as imaging criteria to select patients with large anterior circulation occlusion 6 to 16 hours from last seen well for mechanical thrombectomy. This trial showed a benefit in functional outcome at 90 days in the treated group (mRS score 0–2, 44.6% versus 16.7%; RR, 2.67; 95% CI, 1.60–4.48; $P<0.0001$).[109] Benefit was independently demonstrated for the subgroup of patients who met DAWN eligibility criteria and for the subgroup who did not. DAWN and DEFUSE 3 are the only RCTs showing benefit of mechanical thrombectomy >6 hours from onset. Therefore, only the eligibility criteria from one or the other of these trials should be used for patient selection. Although future RCTs may demonstrate that additional eligibility criteria can be used to select patients who benefit from mechanical thrombectomy, at this time, the DAWN or DEFUSE-3 eligibility should be strictly adhered to in clinical practice.

MEKANİK TROMBEKTOMİ-DAWN ÇALIŞMASI

90 gün sonunda fonksiyonel bağımsızlık;

trombektomi grubunda % 49,

kontrol grubunda %13 saptanmış ……..($p<0.001$)

Erken klinik yanıt;

Trombektomi grubunda %48,

kontrol grubunda %19 ……..($p<0.001$),

DWI-ASPECT

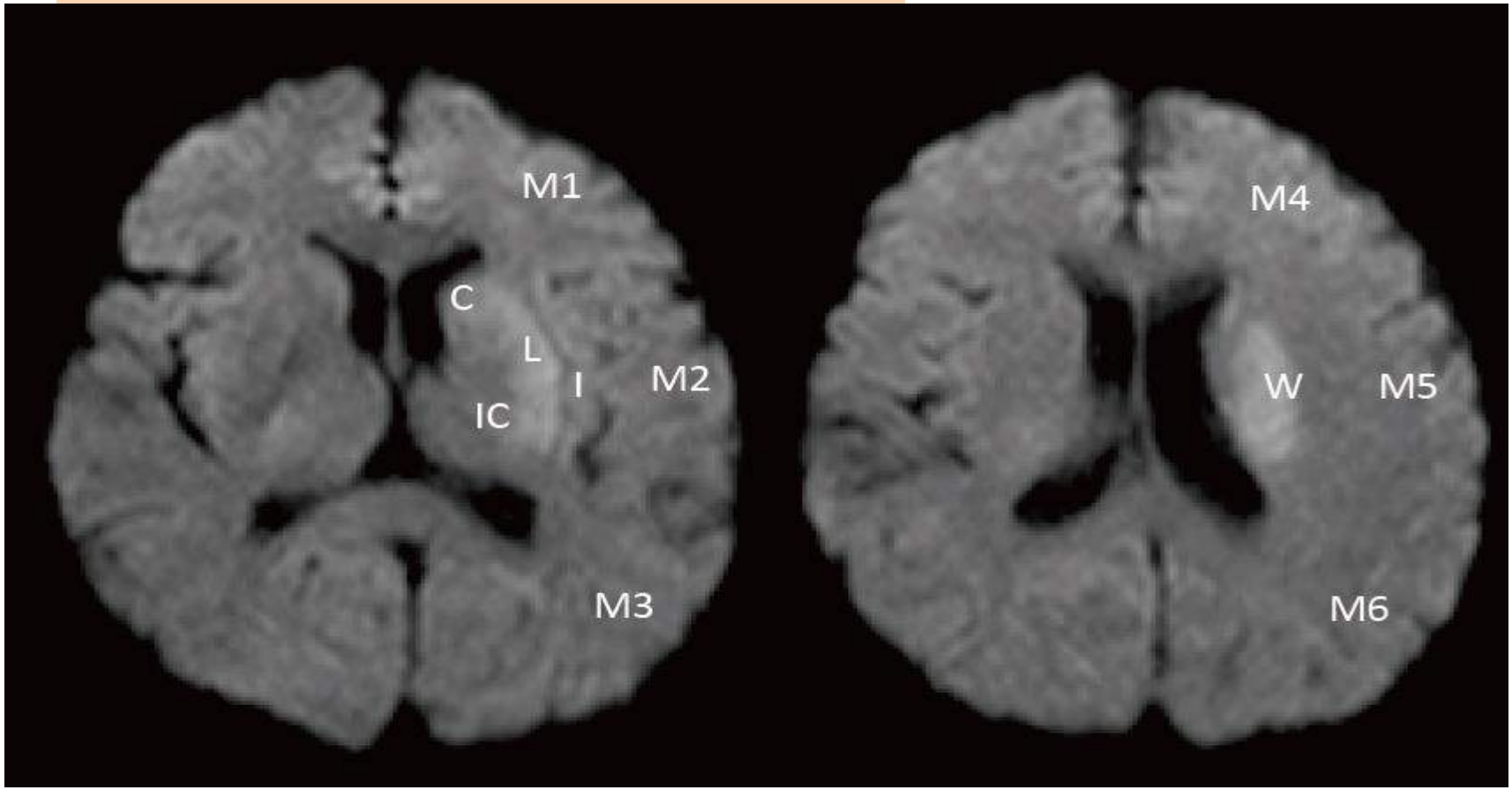


Figure 1 : DWI ASPECTS is evaluated in 11 regions: 10 ASPECTS (Alberta stroke programme early CT score) sites and a white matter (W) lesion. If abnormal signals due to infarction are detected, the count is 0; if they are not detected, the count is 1. If no infarctions are ultimately observed, the total score is 11; if infarction is observed in all target regions, the total score is 0. C: caudate,; L: lentiform,; IC: internal capsule,; I: insular ribbon,; M1: anterior middle cerebral artery (MCA) cortex,; M2: MCA cortex lateral to the insular ribbon,; M3: posterior MCA cortex,; M4, M5, and M6 are anterior, lateral, and posterior MCA territories, respectively, immediately superior to M1, M2, and M3, respectively, rostral to basal ganglia,; W: white matter (corona radiate).

Keigo et al. *J Med Dent Sci 2012: 59: 57–63*

DWI-ASPECT ile iskemik kor volümü arasında korelasyon vardır

DWI ASPECT	CORE VOLUME
≥7	≤25
≥5	≤70
≥3	≤100

SPECIAL TOPIC
doi: 10.2176/nmc.st.2020-0357
Neurol Med Chir (Tokyo) 61, 163–192, 2021
Online February 11, 2021

Guidelines for Mechanical Thrombectomy in Japan, the Fourth Edition, March 2020: A Guideline from the Japan Stroke Society, the Japan Neurosurgical Society, and the Japanese Society for Neuroendovascular Therapy

Hiroshi YAMAGAMI,[1] Mikito HAYAKAWA,[2] Manabu INOUE,[3] Koji IIHARA,[4]

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Hiroshi YAMAGAMI,[1] Mikito HAYAKAWA,[2] Manabu INOUE,[3] Koji IIHARA,[4]

- NIHSS skoru ≥10 ise
- iskemik kor hacmi ≤25 mL ise (bu, ≥7 DWI-ASPECTS'e karşılık gelir)
- ICA veya MCA M1 oklüzyonu olan
- 6-16 saat içindeki hastalara

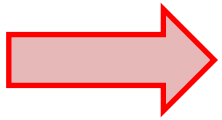
MT güçlü bir öneri olarak tavsiye edilir.

Vaka Seçiminde;

- DAWN ve DEFUSE çalışmaları haricinde bahsedeceğim çalışmalardan ilki:

- WAKE-UP protokolü olarak da bilinen

MRI-Guided Thrombolysis for Stroke with Unknown Time of Onset.



Yani başlangıcını bilmediğimiz inme hastalarına MRG kılavuzluğunda trombolitik versek nasıl olur?

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 16, 2018 VOL. 379 NO. 7

MRI-Guided Thrombolysis for Stroke with Unknown Time of Onset

G. Thomalla, C.Z. Simonsen, F. Boutitie, G. Andersen, Y. Berthezene, B. Cheng, B. Cheripelli, T.-H. Cho, F. Fazekas,

- Çok merkezli bir çalışmada,
- İnme başlangıç zamanı bilinmeyen hastalar
  - intravenöz alteplaz alan
  - plasebo
    - Olmak üzere 2 gruba rastgele seçilmiş.
- Mekanik trombektomi planlanan hastalar çalışma dışı bırakılmış.
- Tüm hastalarda, MRG difüzyon ağırlıklı görüntülemede görünen ancak FLAIR sekanslarında herhangi bir parankim hiperintensitesi olmayan hastalar çalışmaya alınmış.

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RESULTS

The trial was stopped early owing to cessation of funding after the enrollment of 503 of an anticipated 800 patients. Of these patients, 254 were randomly assigned to receive alteplase and 249 to receive placebo. A favorable outcome at 90 days was reported in 131 of 246 patients (53.3%) in the alteplase group and in 102 of 244 patients (41.8%) in the placebo group (adjusted odds ratio, 1.61; 95% confidence interval [CI], 1.09 to 2.36; P=0.02). The median score on the modified Rankin scale at 90 days was 1 in the alteplase group and 2 in the placebo group (adjusted common odds ratio, 1.62; 95% CI, 1.17 to 2.23; P=0.003). There were 10 deaths (4.1%) in the alteplase group and 3 (1.2%) in the placebo group (odds ratio, 3.38; 95% CI, 0.92 to 12.52; P=0.07). The rate of symptomatic intracranial hemorrhage was 2.0% in the alteplase group and 0.4% in the placebo group (odds ratio, 4.95; 95% CI, 0.57 to 42.87; P=0.15).

CONCLUSIONS

In patients with acute stroke with an unknown time of onset, intravenous alteplase guided by a mismatch between diffusion-weighted imaging and FLAIR in the region of ischemia resulted in a significantly better functional outcome and numerically more intracranial hemorrhages than placebo at 90 days. (Funded by the European Union Seventh Framework Program; WAKE-UP ClinicalTrials.gov number, NCT01525290; and EudraCT number, 2011-005906-32.)

	Alteplase Group (N = 254) %	Placebo Group (N = 249)	P değeri
İyi klinik sonlanım - 90 günde	131/246 (53.3)	102/244 (41.8)	0.02
Median İnfarkt hacmi	3.0 (0.8–17.7)	3.3 (1.1–16.6)	0.32¶
Parenchymal hemorrhage type 2	10 (4.0)	1 (0.4)	0.03

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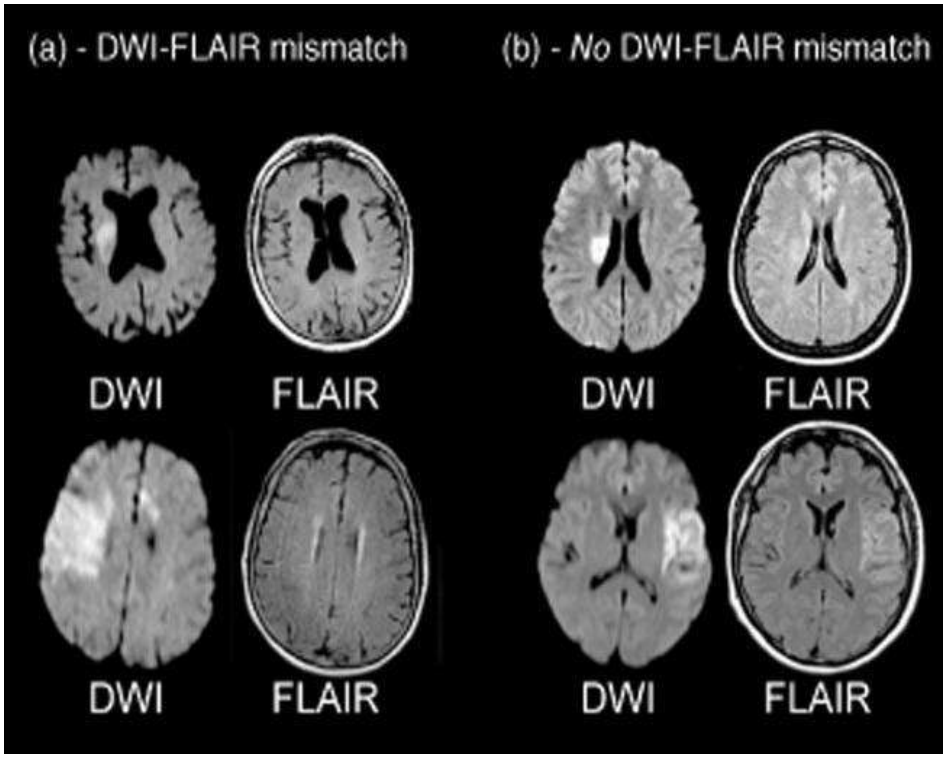
- Başlangıç zamanı bilinmeyen, iskemi bölgesinde difüzyon pozitif / FLAIR negatif hastalarda intravenöz alteplaz,

- 90 günde plaseboya göre anlamlı ölçüde daha iyi bir fonksiyonel sonuç ve sayısal olarak daha fazla intrakraniyal kanama ile sonuçlanmıştır.



Difüzyon lezyonu olan ama FLAIR lezyonu olmayan alanın geniş olması ["Difüzyon Pozitif FLAIR Negatif" veya kısaca "DPFN" kriteri]

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Diff MRG de iskemi gözlenen

FLAIR MRG de iskemik alan olmayan

inmenin yaklaşık olarak önceki 4.5 saat içinde meydana geldiğini gösterir.

- Ayrıca, hiperintens FLAIR lezyonlarının varlığı,
  - geç evre inmelerin olası bir göstergesi olmasının yanı sıra,
  - 3 saat içinde tedavi edilen hastalarda da semptomatik intrakraniyal kanama (sICH) riskinin artmasıyla bağlantılıdır.
- Dolayısıyla ilk 3 saat içinde akut FLAIR lezyonu olanlarda hemoraji riski yüksektir.

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- WAKE-UP çok merkezli çalışmasında IVT zaman penceresi uzamasa da;
  - Uyanma İnmeli veya GBİ'li hastaların 0-4,5 saatlik zaman penceresinde olup olmadıklarına dair bilgi vermesi açısından
    - DWI/FLAIR mismatch yönteminin kullanımı konusunda önemli bir çalışma olmuştur.

Aoki ve ark. Tarafından 2010 yılında

- DWI FLAIR uyumsuzluğunun
  - %78'lik bir duyarlılık ve
  - %83'lük pozitif prediktif değeri
    - ile <4.5 saatte inme başlangıcını öngördüğü gösterilmiştir.

  - Aoki J, Kimura K, Iguchi Y*, et al.* FLAIR can estimate the onset time in acute ischemic stroke patients. *J Neurol Sci* 2010; 293: 39–44.

- ESO IVT kılavuzları, Uyanma inmelerinde;
- DWI/FLAIR disosiyasyonu olan hastalarda trombolitik tedaviyi önermektedir.
  - kanıt kalitesi>>>yüksek;
  - öneri gücü>>>güçlü

Guideline

EUROPEAN STROKE JOURNAL

European Stroke Journal
0(0) 1–47
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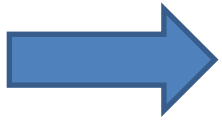
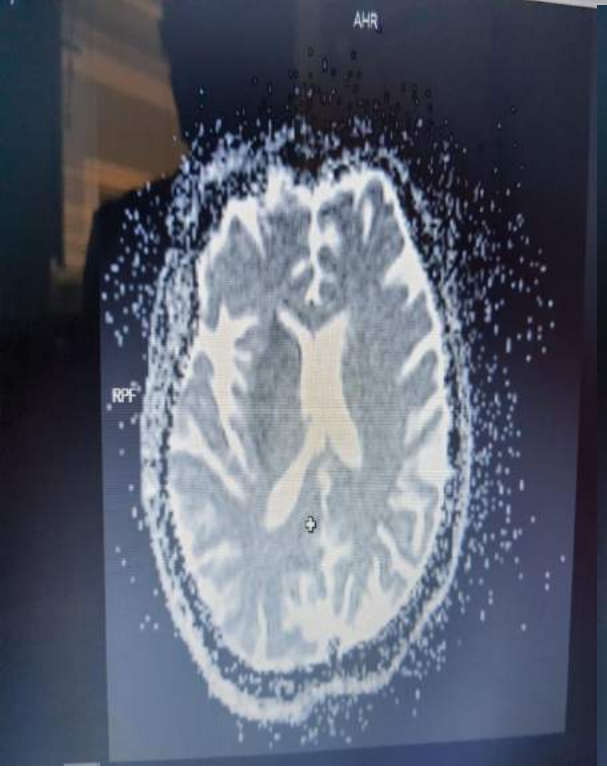
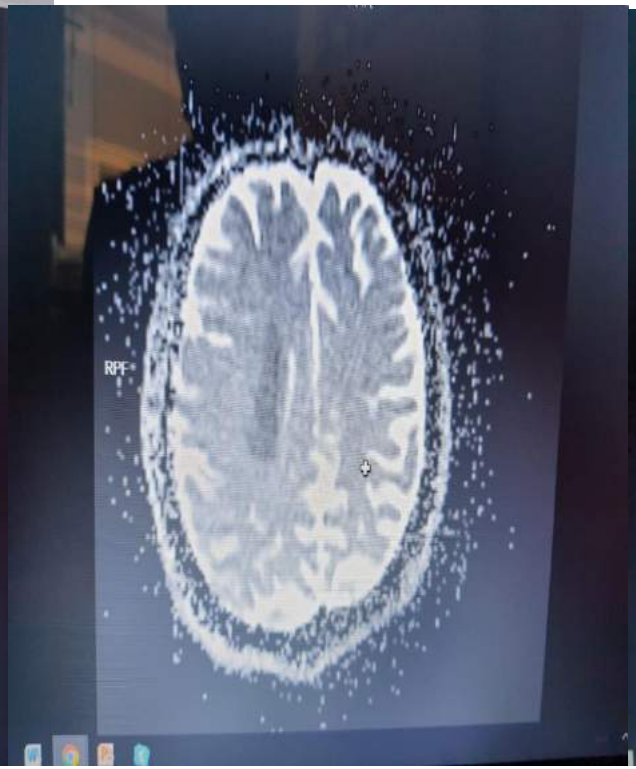
European Stroke Organisation (ESO) – European Society for Minimally Invasive Neurological Therapy (ESMINT) guidelines on mechanical thrombectomy in acute ischaemic stroke

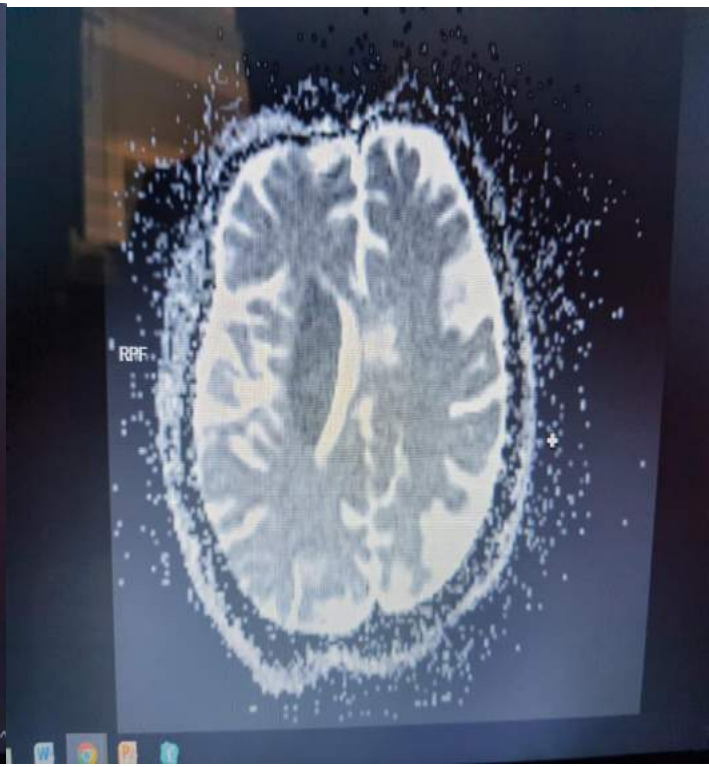
Olgu Örneği

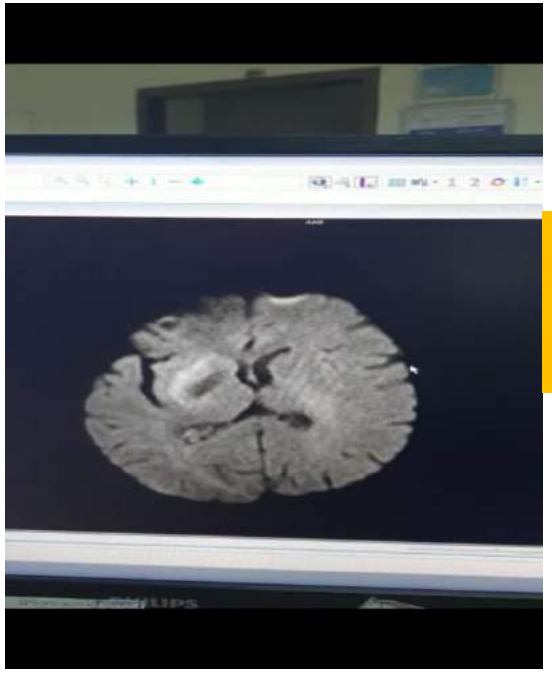


- 66 y K hasta
- Geliş NIHS skoru 10
- Gece 3 gibi yataktan düşmüş
- Bilinç letarjik
- Sol hemiparezi üst 2/5 alt 1 /5

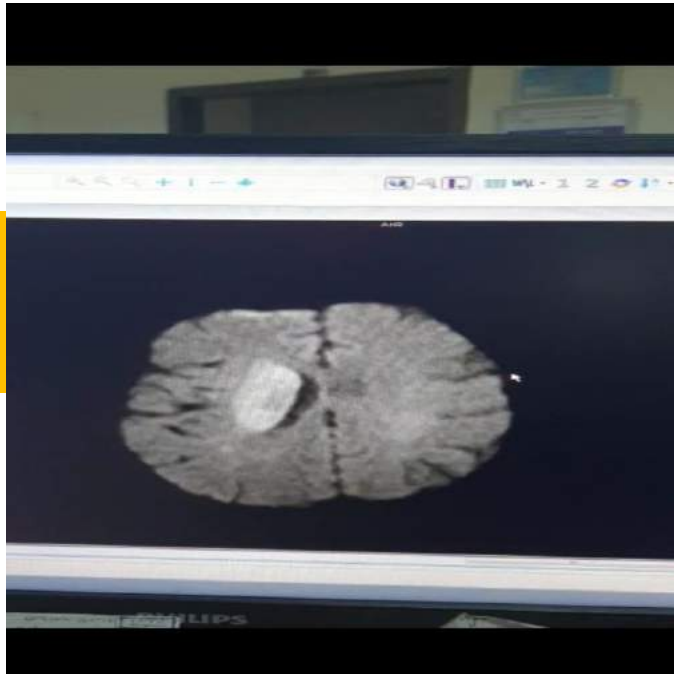






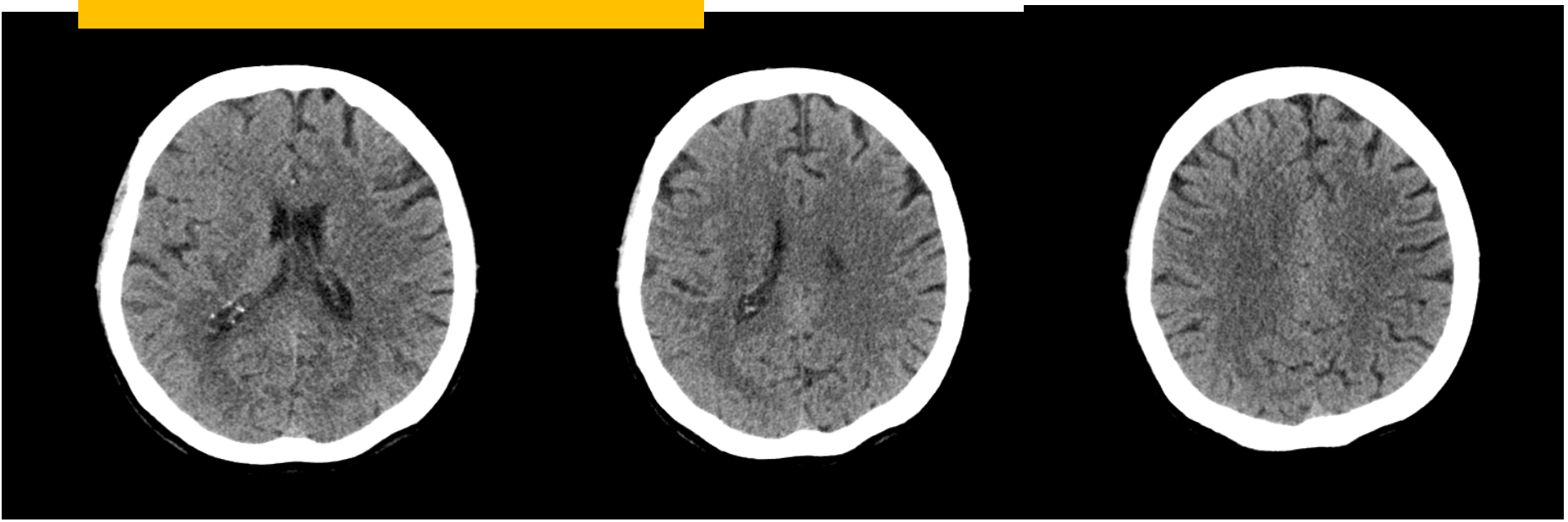


Diffüzyon ve ADC Görüntüleri

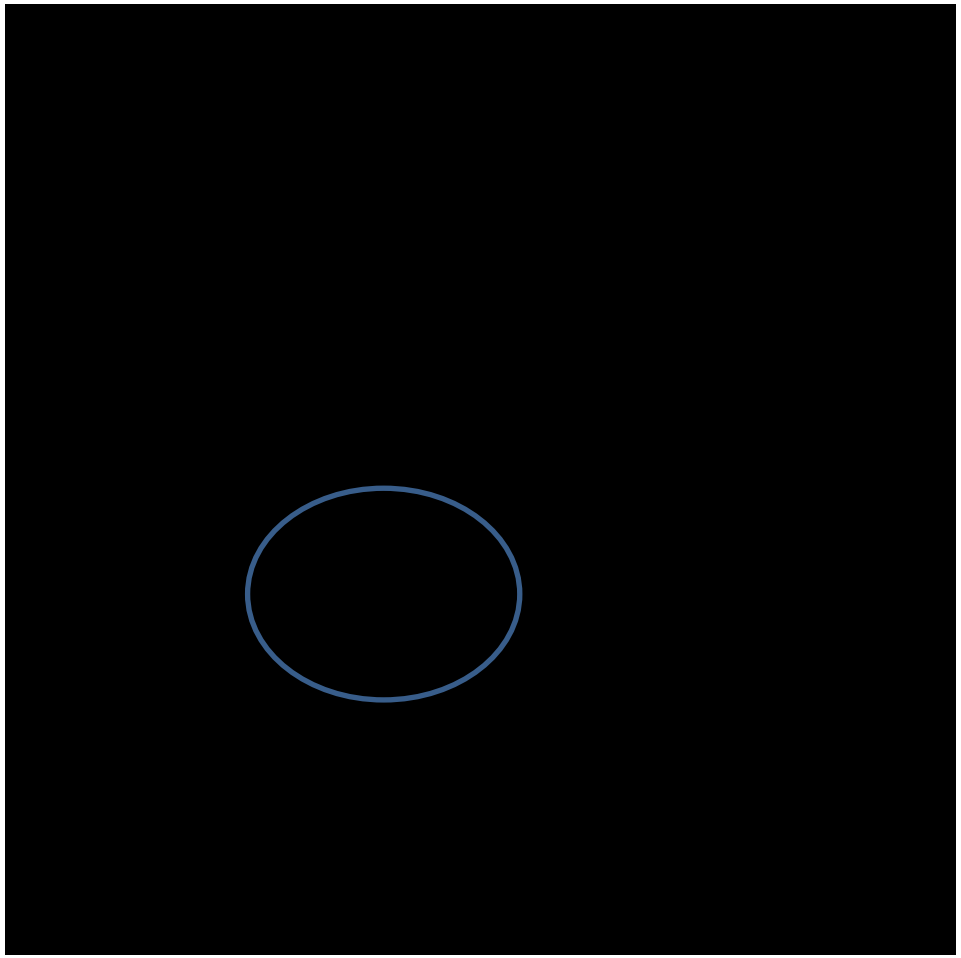


FLAIR görüntüler

Başvuru ASPECT :10

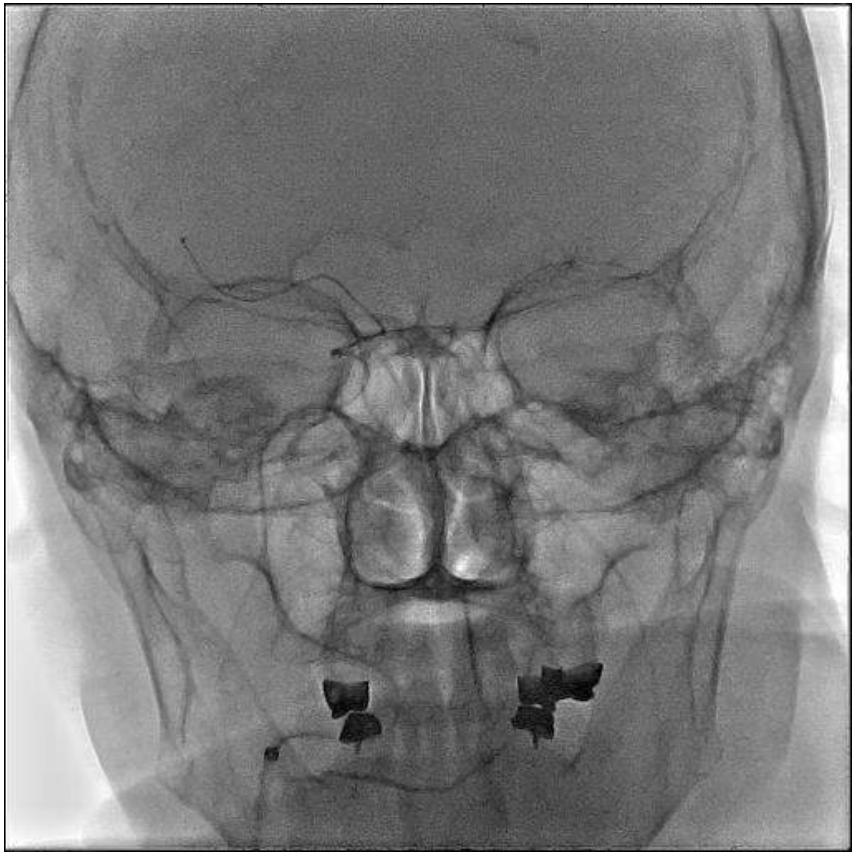


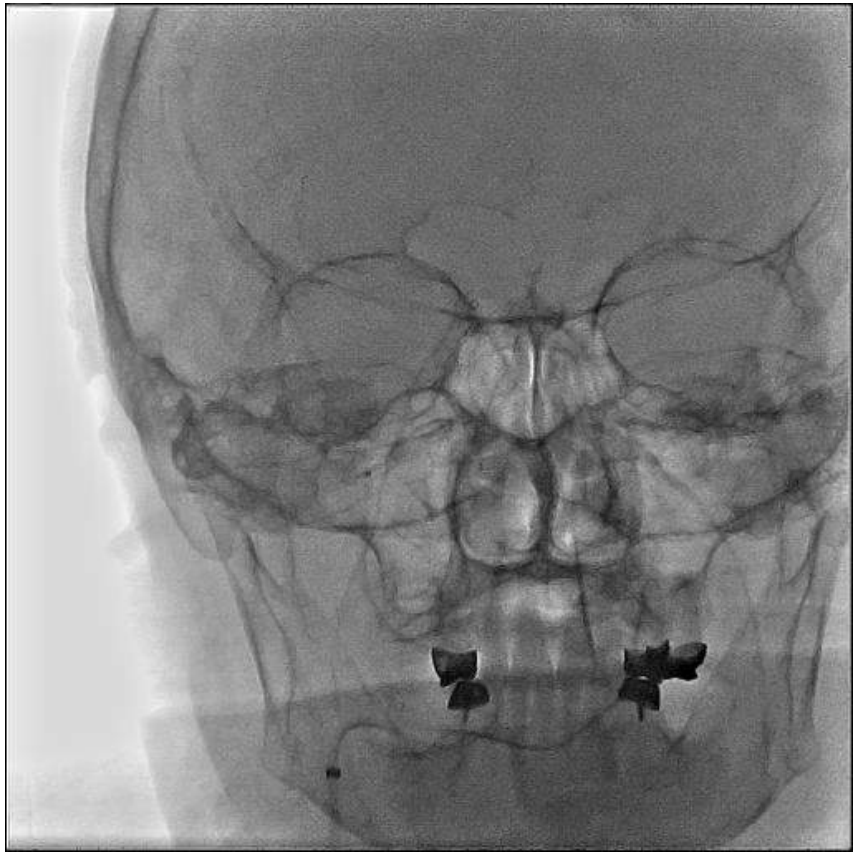
Sağ MCA M1 oklude



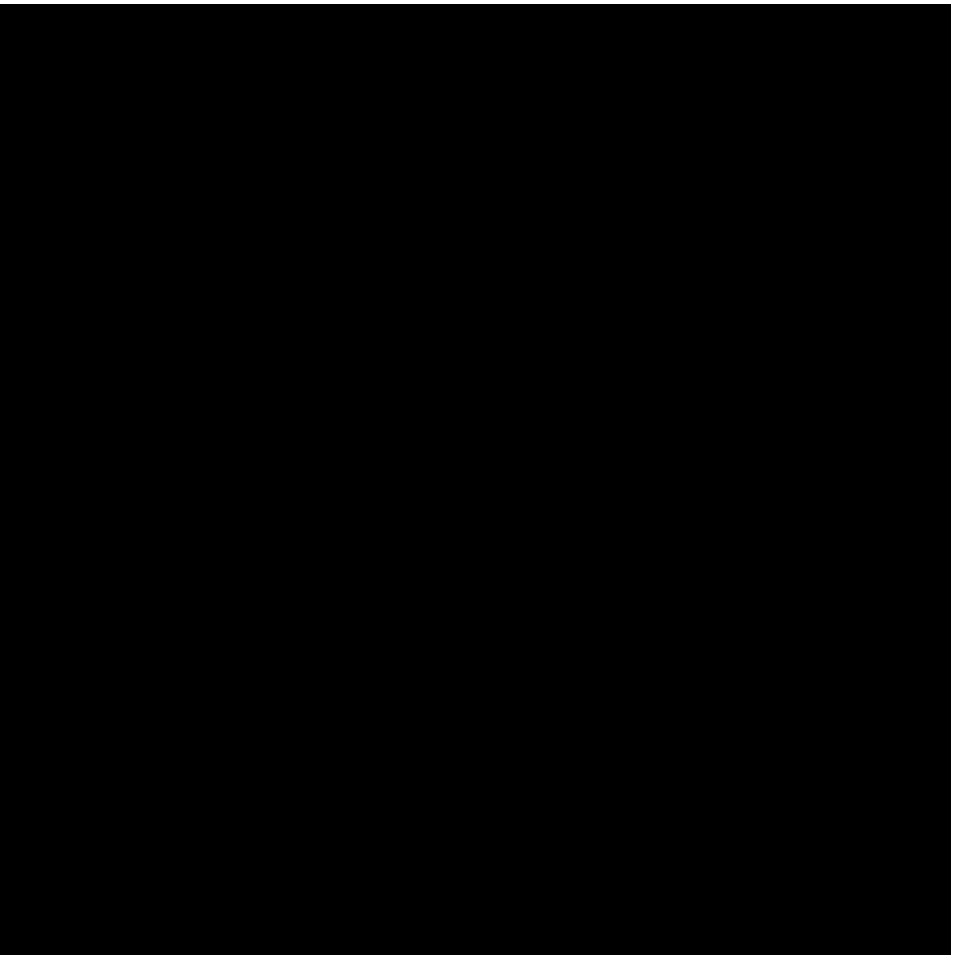
1. Pass

Stent retriever

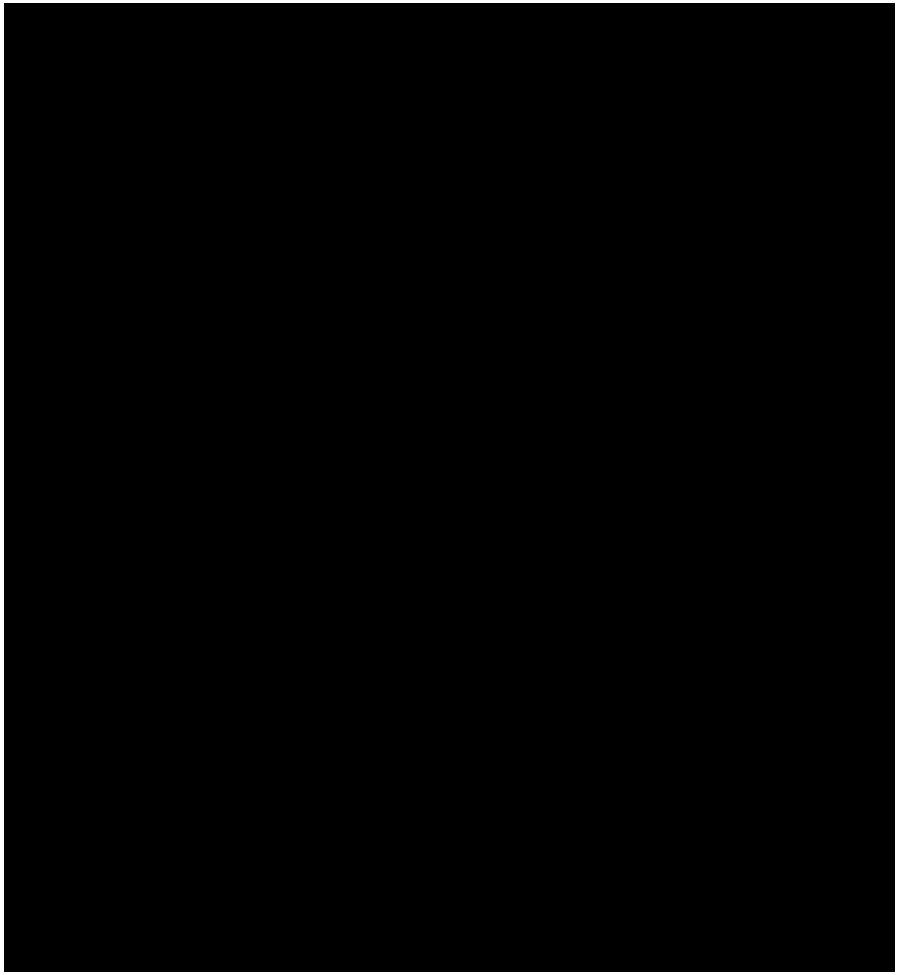




1. pass 😔

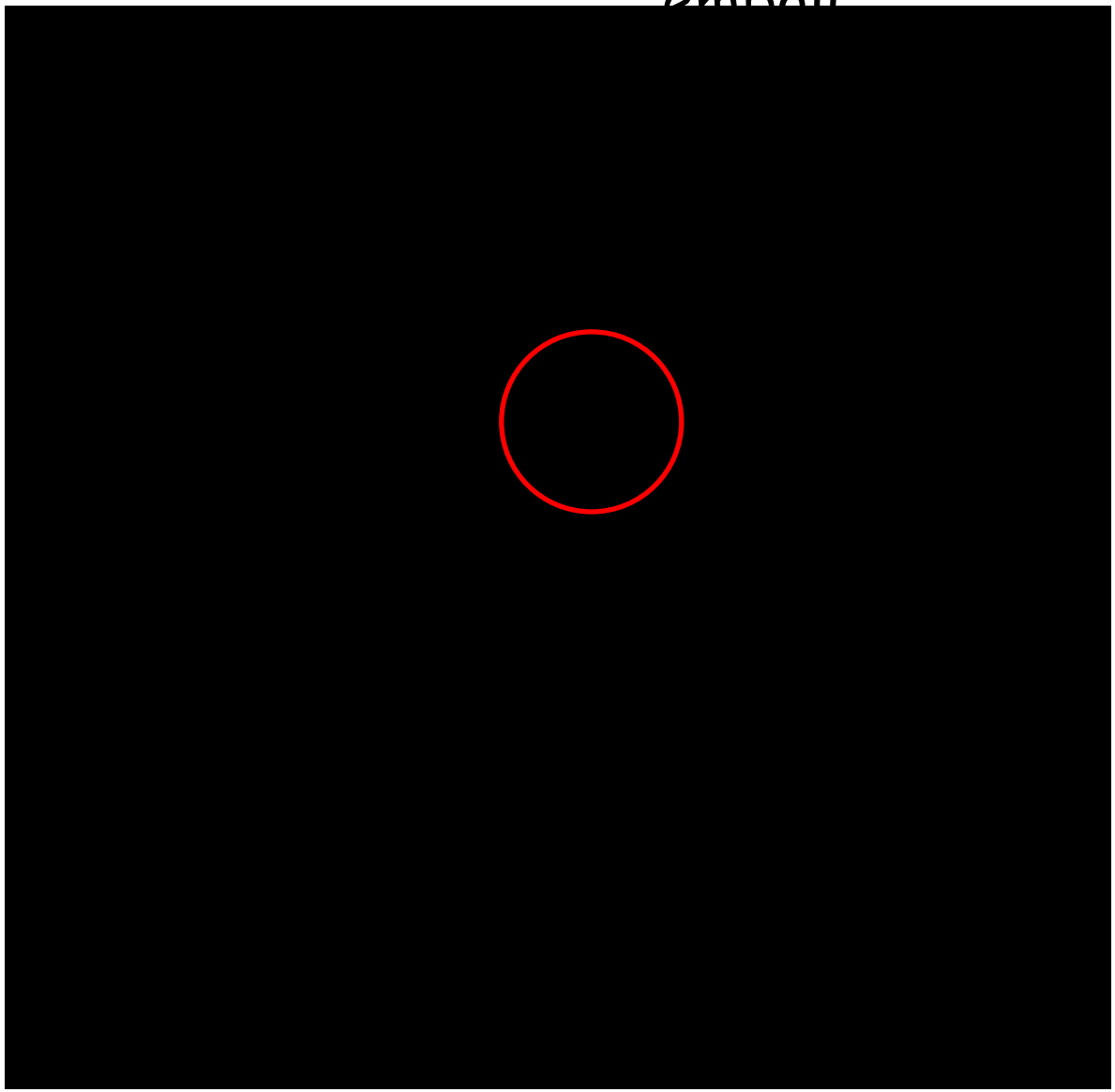


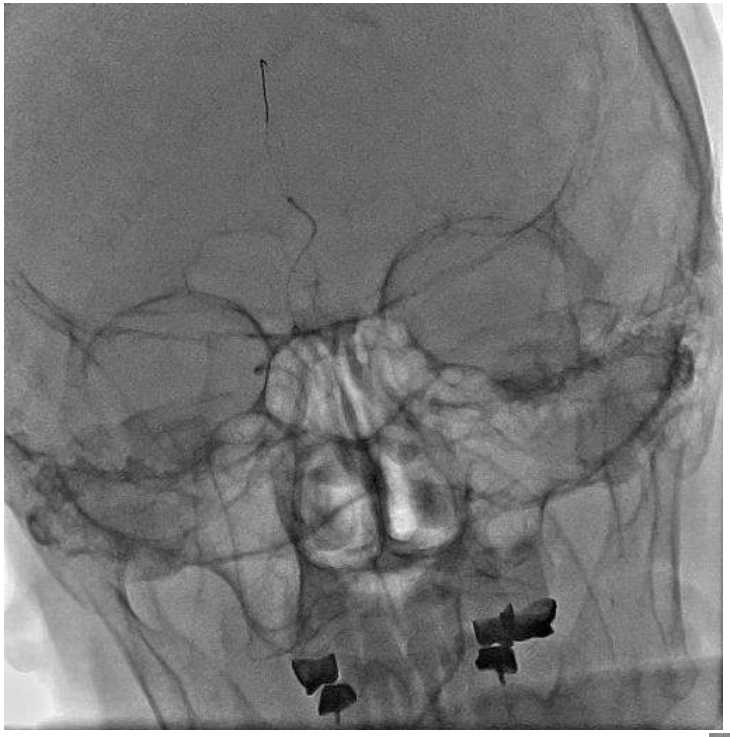
2. pass 😔

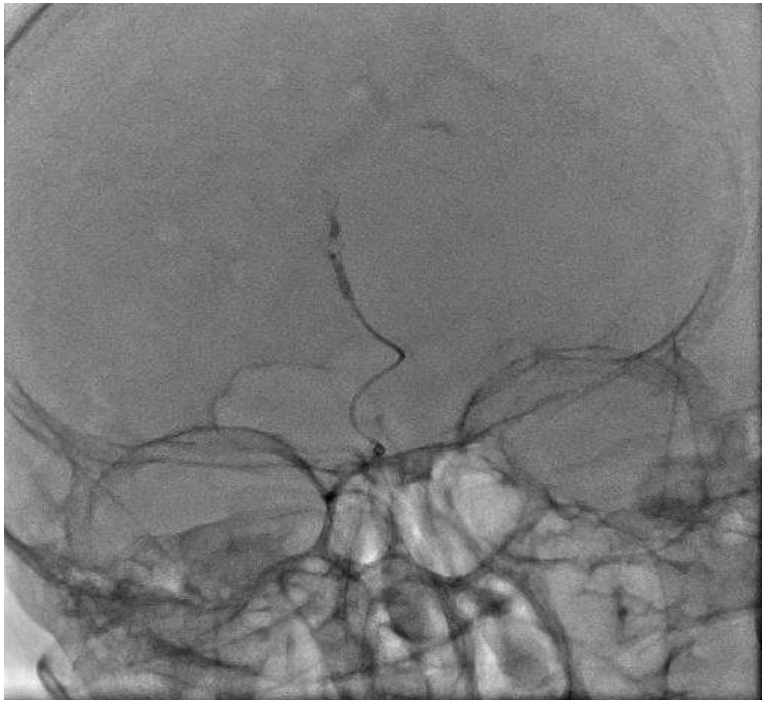


3. pass

Sağ ACA A2 de distal embeli

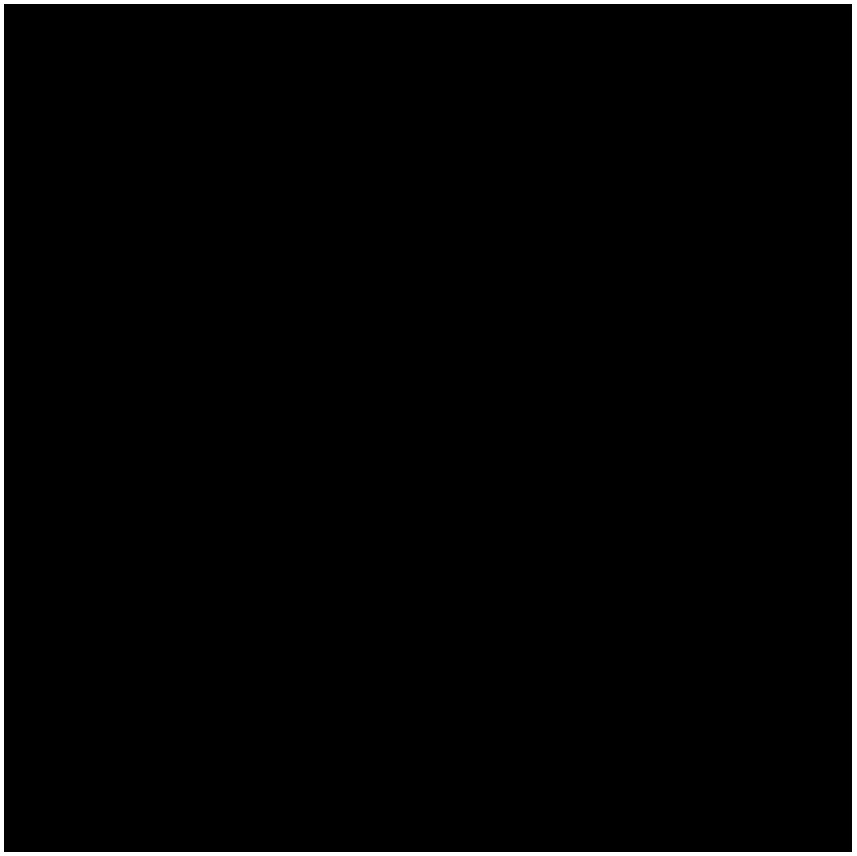


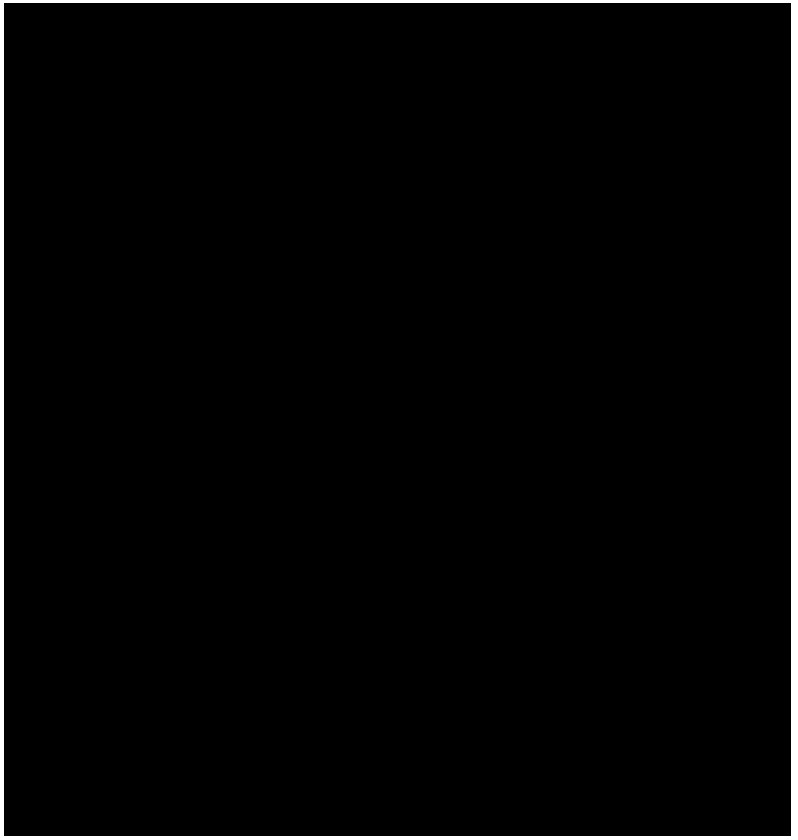


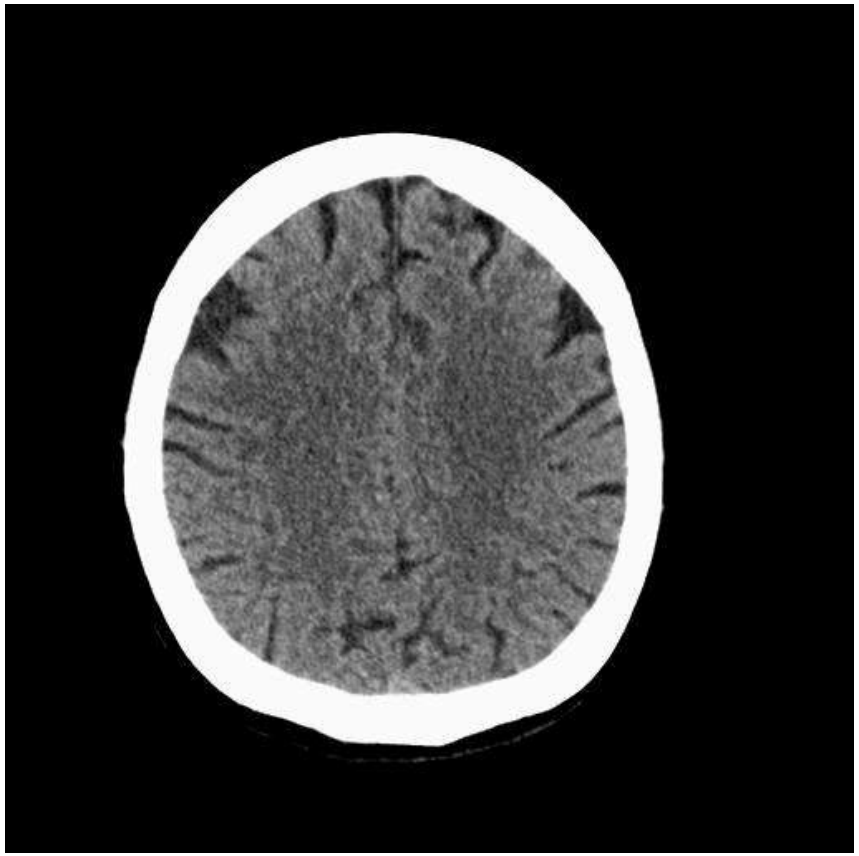


ACA A2 4x40
Stent retriever

ACA A2 tek pass rekanalizasyon







Çıkış Muayenesi

- SOL ÜST EKSTREMİTE KAS GÜCÜ
  - PROKSİMAL 1/5 DİSTAL 0.
- SOL ALT EKSTREMİTE KAS GÜCÜ
  - KALÇA FLEKSİYONU 1+/5
  - DiZ FLEKSİYONU 0
  - DİZ EKSTANSİYONU 2/5
  - AYAK DORSİFLEKS VE PLANTAR FLEKS 0

Intravenous Thrombolysis in Unwitnessed Stroke Onset: MR WITNESS Trial Results

Lee H. Schwamm, MD,[1*] Ona Wu, PhD,[2*] Shlee S. Song, MD,[3]

Methods: Patients aged 18 to 85 years with AIS of unwitnessed onset at 4.5 to 24 hours since they were last known to be well, treatable within 4.5 hours of symptom discovery with intravenous alteplase (0.9mg/kg), and presenting with qDFM were screened across 14 hospitals. The primary outcome was the risk of symptomatic intracranial hemorrhage (sICH) with preplanned stopping rules. Secondary outcomes included symptomatic brain edema risk, and functional outcomes of 90-day modified Rankin Scale (mRS).

Results: Eighty subjects were enrolled between January 31, 2011 and October 4, 2015 and treated with alteplase at median 11.2 hours (IQR = 9.5–13.3) from when they were last known to be well. There was 1 sICH (1.3%) and 3 cases of symptomatic edema (3.8%). At 90 days, 39% of subjects achieved mRS = 0–1, as did 48% of subjects who had vessel imaging and were without large vessel occlusions.

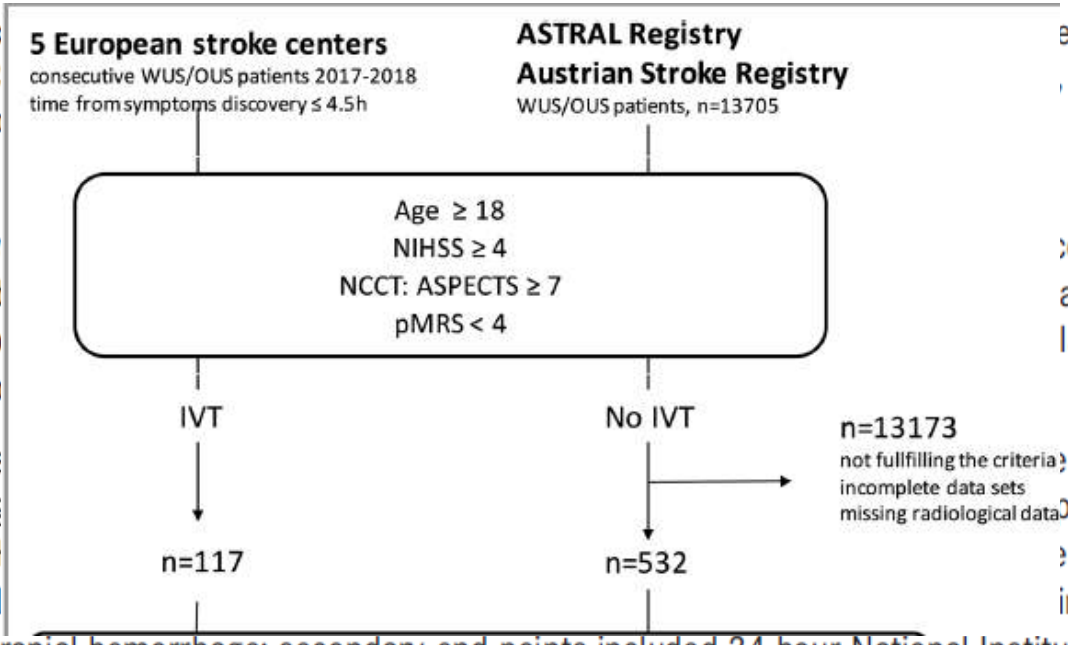
ANN NEUROL 2018;83:980–993

- 80 hasta … 18-85 yaş arası
- 4.5-24 saat içinde başvuran
- Quantative-DWI –FLAIR mismatch saptanan hastalar
- 0.9 mg / kg IV tpa
- Hastalar ortalama 11.2 saat içinde IV tpa almış
- 1 hasta…..% 1.3 sICH;
- 3 hasta…..% 3.8 semptomatik ödem
- % 39 hastada mRS..0-1 arası

- Uyanma İnmesi ve GBİ'li hastalarda
  - Yalnızca Kontrastsız BBT kullanarak vaka seçimi yapılan ikinci çalışma;

Thrombolysis in Stroke With Unknown Onset Based on Non-Contrast Computerized Tomography (TRUST CT)

Marek Sykora, MD, PhD, MSc; Lars Kellert, MD; Patrik ... errari, MD; Stefan Krebs, MD; Wilfried Lang, MD; Wolfgang ... MD; Benjamin Bender, MD; Annerose Mengel, MD; Khoulc



Background—Intravenous thrombolysis (IVT) in w ...cently proven to be safe and effective using advanced ...aphy-perfusion) for patient selection. However, in most ...lable. We hypothesize that pragmatic non-contrast comp

Methods and Results—TRUST-CT (Thrombolysis ...rized Tomography) is an international multicenter reg ...uted tomography-based IVT with National Institute of H ...rized Tomography score ≥7 were included and compared ...imary end point was the incidence of symptomatic intracranial hemorrhage; secondary end points included 24-hour National Institute of Health Stroke Scale improvement of ≥4 and modified Rankin Scale at 90 days. One hundred and seventeen WUS/SUO patients treated with non-contrast computed tomography-based IVT were included. As compared with 112 controls, the median admission National Institute of Health Stroke Scale was 10 and the median Alberta Stroke Program Early Computerized Tomography score was 10 in both groups. Four (3.4%) IVT patients and one control patient (0.9%) suffered symptomatic intracranial hemorrhage (adjusted odds ratio 7.9, 95% CI 0.65–96, P=0.1). A decrease of ≥4 National Institute of Health Stroke Scale points was observed in 67 (57.3%) of IVT patients as compared with 25 (22.3%) in controls (adjusted odds ratio 5.8, CI 3.0–11.2, P<0.001). A months, 39 (33.3%) IVT patients reached a modified Rankin Scale score of 0 or 1 versus 23 (20.5%) controls (adjusted odds ratio 1.94, CI 1.0–3.76, P=0.05).

Conclusions—Non-contrast computed tomography-based thrombolysis in WUS/SUO seems feasible and safe and may be effective. Randomized prospective comparisons are warranted.

- ESO kılavuzları,
  - 4,5-9 saatlik zaman aralığında
  - kontrastsız BT'ye dayalı IVT'nin etkinjiğini

kanıt kalitesi, orta;
öneri gücü, güçlü
olarak önermektedir.

ORIGINAL RESEARCH

NCCT and CTA-based imaging protocol for endovascular treatment selection in late presenting or wake-up strokes

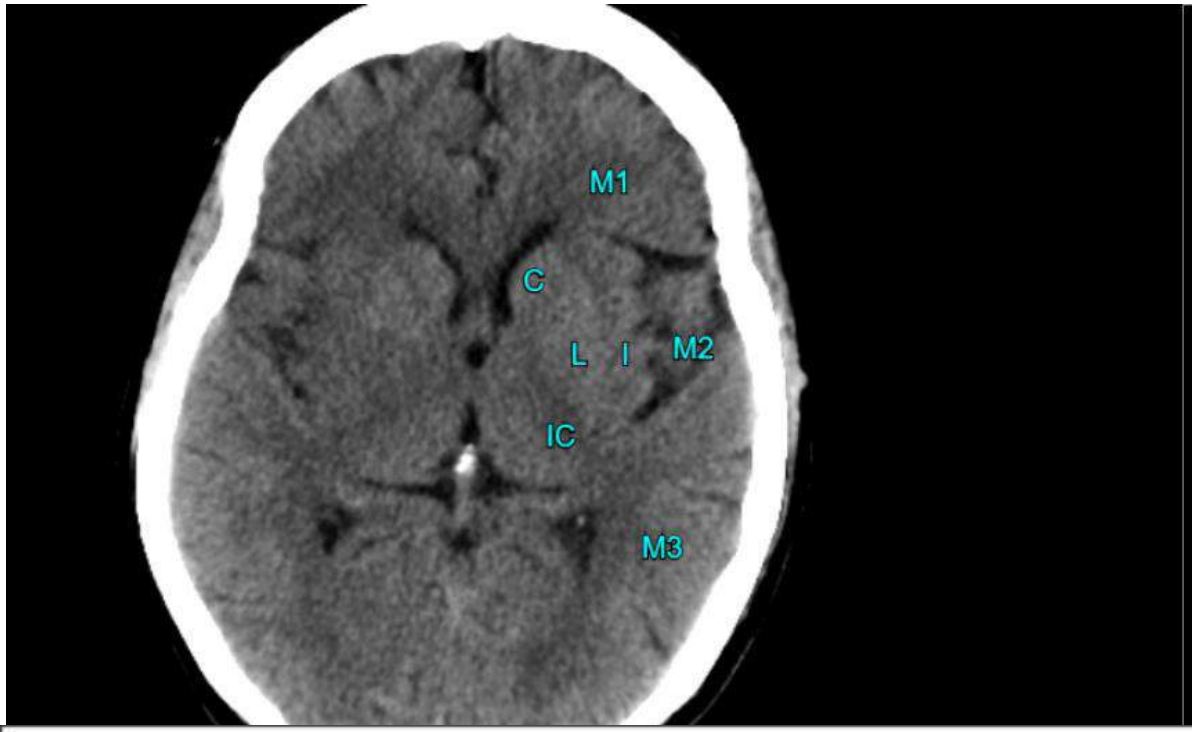
Telma Santos,[1] Andreia Carvalho,[1] André Almeida Cunha,[2] Marta Rodrigues,[2] Tiago Gregório,[3] Ludovina Paredes,[3] Henrique Costa,[1,3] José Mário Roriz,[4] João Pinho,[5] Miguel Veloso,[1,3] Sérgio Castro,[2] Pedro Barros,[1,3] Manuel Ribeiro[2]

Santos T, *et al*. *J NeuroIntervent Surg* 2018;**0**:1–5.

Methods An observational study was performed, which included consecutive patients with anterior circulation ischemic stroke with large vessel occlusion treated with EVT. Patients presenting within 6 hours were treated if their NIH Stroke Scale (NIHSS) score was ≥6 and Alberta Stroke Program Early CT score (ASPECTS) was ≥6, while patients presenting with WUS or 6–24 hours after last seen well (WUS/LPS) were treated if their NIHSSscore was ≥12 and ASPECTS was ≥7.

Uyanma inmeleri ve Geç Başvuran İnme hastalarında

- 18 yaş ve üzeri,
- bazal mRS skoru 2'nin altında,
- NIH inme skalası skoru 12 ve üzeri
- kontrastsız BT'de Alberta Stroke Programme Early CT Score (ASPECTS) skoru 7 ve üzeri olan
- BTA'da büyük damar oklüzyonu olan hastalar çalışmaya dahil edilmiştir.



Calculating the ASPECTS Score:

Each area of grey white loss constitutes 1 deduction point

Subganglionic Nuclei:

M1 - *Frontal operculum*	-1
M2 - *Anterior temporal lobe*	-1
M3 - *Posterior temporal lobe*	-1

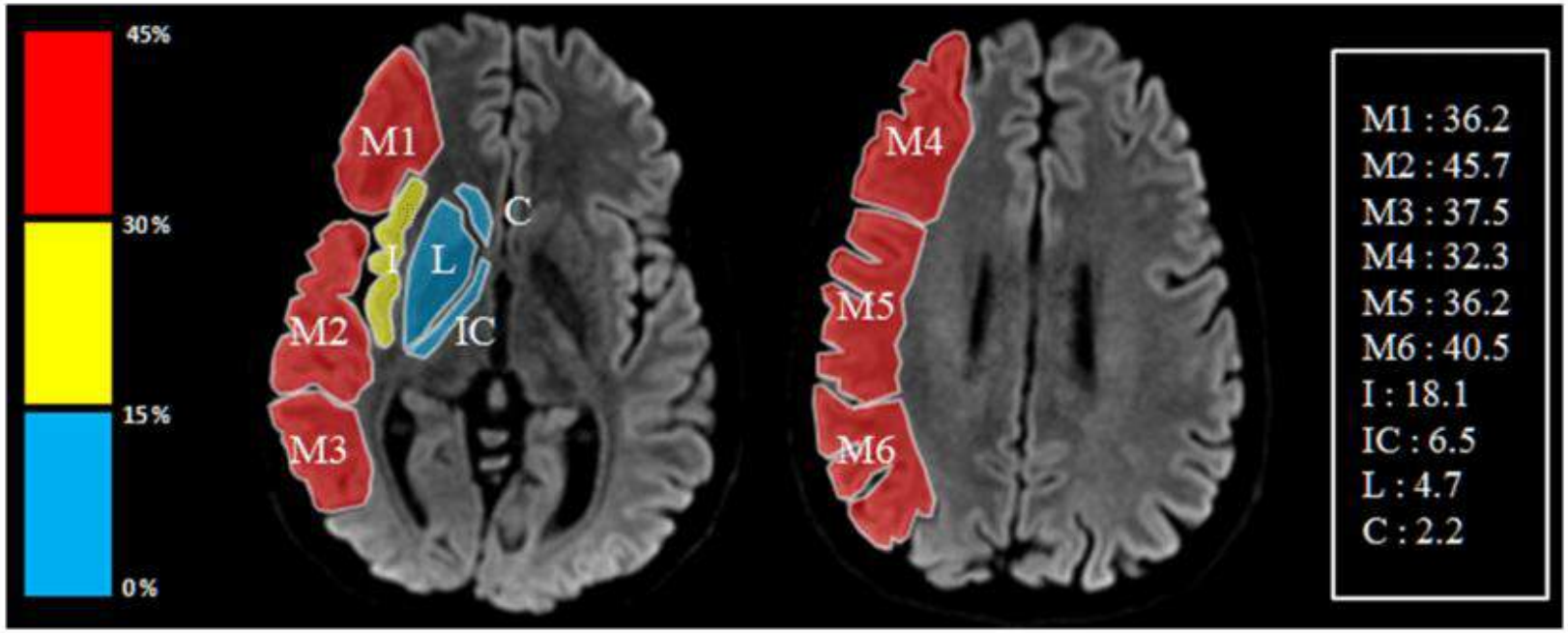
Supraganglionic Nuclei:

M4 - *Anterior MCA*	-1
M5 - *Lateral MCA*	-1
M6 - *Posterior MCA*	-1

Basal Ganglia:

Caudate (C)	-1
Lentiform Nucleus (L)	-1
Insula (I)	-1
Internal Capsule (IC) *any part*	-1

Total ASPECTS Score. **/10**



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252 EVT uygulanan hastalardan 63 (%25.3) hasta 6 saatlik pencere dışında tedavi edilmiş.
Uyanma İnmesi..34 hasta
GBİ...29 hasta

Table 2 Baseline characteristics, interventional procedure data, and outcomes in patients treated 6–24 hours after last seen well

	Wake-up stroke (n=34)	Late presenting stroke (n=29)	P value
Successful recanalization (mTICI ≥2b)	33 (97.1)	27 (93.1)	0.59
NIHSS at 24 hours	8 (3–13)	7 (3–15)	0.825
mRS ≤2 at 3 months	21 (61.8)	20 (69.0)	0.55
Mortality at 3 months	4 (11.8)	1 (3.4)	0.363
Symptomatic ICH	1 (2.9)	1 (3.4)	1
Peri-procedural complications†	3 (8.8)	1 (3.4)	0.618
Tandem occlusion	9 (26.5)	7 (24.1)	0.832

Santos T, *et al*. *J NeuroIntervent Surg* 2018;**0**:1–5.

ORIGINAL RESEARCH

NCCT and CTA-based imaging protocol for endovascular treatment selection in late presenting or wake-up strokes

Telma Santos,[1] Andreia Carvalho,[1] André Almeida Cunha,[2] Marta Rodrigues,[2] Tiago Gregório,[3] Ludovina Paredes,[3] Henrique Costa,[1,3] José Mário Roriz,[4] João Pinho,[5] Miguel Veloso,[1,3] Sérgio Castro,[2] Pedro Barros,[1,3] Manuel Ribeiro[2]

Results 249 patients were included, 63 of whom were in the WUS/LPS group. Baseline characteristics were similar between groups, except for longer symptom-recanalization time, lower admission NIHSS (16 vs 17, P=0.038), more frequent tandem occlusions (25.4% vs 11.8%, P=0.010), and large artery atherosclerosis etiology (22.2% vs 11.8%, P=0.043) in the WUS/LPS group. No differences in symptomatic intracranial hemorrhage, peri-procedural complications or mortality were found between groups. Three-month functional independence was similar in both groups (65.1% in WUS/LPS vs 57.0% in ≤6 hours, P=0.259) and no differences were found after adjustment for confounders.

Santos T, *et al*. *J NeuroIntervent Surg* 2018;**0**:1–5.

- Sonuçlara bakıldığında
- 3. ay mortalite oranlarında
  - %15.6 ilk 6 saat grubunda,
  - %7.9, uyanma ve GBİ grubunda, p=0.126) ve
- 3. ay iyi klinik sonlanım,
  - ilk 6 saatte başvuran hastalarda %57.0 iken
  - uyanma ve GBİ grubunda % 65.1 olarak raporlanmıştır (p=0.259).

- Ek olarak uyanma ve GBİ hastaları arasında sonlanım noktaları açısından istatistiksel anlamlı fark gözlenmemiştir.

ORIGINAL RESEARCH

NCCT and CTA-based imaging protocol for endovascular treatment selection in late presenting or wake-up strokes

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Conclusions This real-world observational study suggests that EVT may be safe and effective in patients with WUS and LPS selected using clinical-core mismatch (high NIHSS/high ASPECTS in NCCT).

Sonuç

- Yüksek NIHSS (12 ve üzeri)
- Kontrastsız BT'de yüksek ASPECTS (7 ve üzeri)
- kullanılarak seçilen Uyanma inmeleri ve Geç Başvuran İnme hastalarında;
- EVT'nin güvenli ve etkili olabileceğini düşündürmektedir.

Santos T, *et al*. *J NeuroIntervent Surg* 2018;**0**:1–5.

Original research

Endovascular thrombectomy for anterior circulation stroke beyond 6 hours of onset in Sweden 2015 to 2020: rates and outcomes in a nationwide register-based study

Teresa Ullberg ,[1,2] Mia von Euler,[3] Per Wester,[4,5] Fabian Arnberg,[6] Bo Norrving,[2] Tommy Andersson,[6,7] Johan Wassélius[1]

Results Late window EVT increased from 0.3% of all IS in 2015 to 1.8% in 2020, and from 17.4% of all anterior circulation EVTs in 2015 to 32.9% in 2020. Of 2199 patients, 76.9% (n=1690) were early window EVTs and 23.1% late window EVTs (n=509; 141 known onset, 368 LSW). Median age was 73 years, and 46.2% were female, with no differences between groups. Favorable outcome did not differ between groups (early window 42.4%, late window known onset 38.9%, late window LSW 37.3% (p=0.737)) and remained similar when adjusted for baseline differences. sICH rates did not differ (early window 4.0%, late window known onset 2.1%, late window LSW 4.9% (p=0.413)).

Conclusion Late window EVTs have increased substantially over time, and currently account for one third of anterior circulation treatments. Early and late window patients had similar outcomes.

Patient selection

We included all patients with anterior circulation large vessel occlusion acute IS, defined as occlusion of the intracranial portion of the internal carotid artery or the M1 or M2 segment of the middle cerebral artery on digital subtraction angiography (DSA), who were registered in both Riksstroke and EVAS from January 1, 2015 to December 31, 2020 and had groin puncture with the intention of EVT, were pre-stroke independent defined as modified Rankin Scale (mRS) score of 0–2, and had registered onset-to-groin (OTG) times.

Original research

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Teresa Ullberg ,[1,2] Mia von Euler,[3] Per Wester,[4,5] Fabian Arnberg,[6] Bo Norrving,[2] Tommy Andersson,[6,7] Johan Wassélius[1]

Table 1 Patient characteristics in 2199 patients with anterior circulation LVO stroke treated in the early (<6 hours) and late (6–24 hours) time windows. Missing data were <2% for all variables

Variable	Early window reference n=1690, % (n)	Late window known onset n=141, % (n)	Late window LSW n=368, % (n)	P value
Stroke characteristics				
Median NIHSS (IQR)	16 (11–20)	12 (7–17)	15 (11–19)	<0.001
Wake-up stroke	3.2% (54)	0% (0)	61.1% (225)	<0.001
MCA, M2	29.4% (497)	39.0% (55)	25.0% (92)	
Reperfusion rate				0.141
mTICI 2b–3	84.9% (1418)	80.6% (112)	87.5% (321)	
Early neurological outcome				
24 hours NIHSS, median (IQR)	6 (2–14)	7 (3–15)	8 (3–16)	0.002
Adverse events				
sICH	4.0% (67)	2.1% (3)	4.9% (18)	0.413

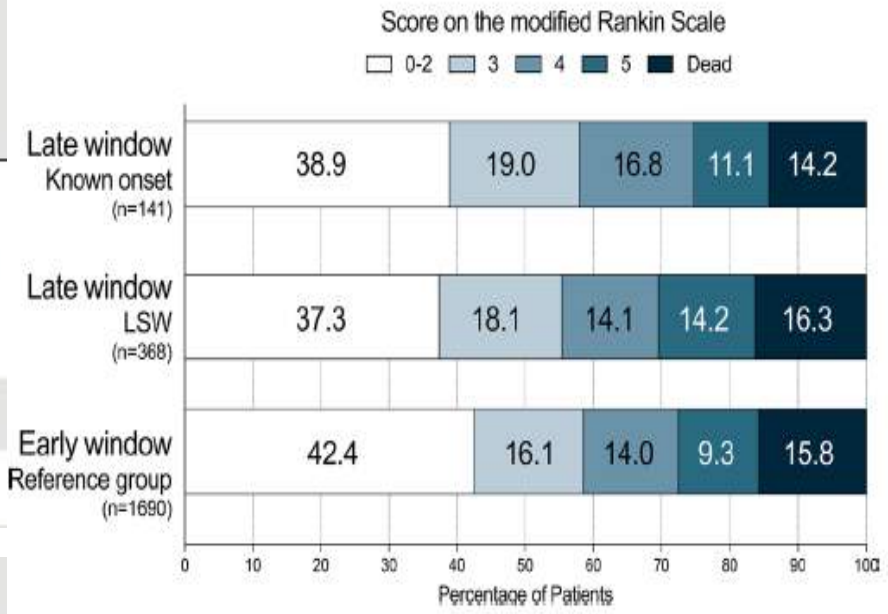

Figure 3 90-day functional outcome stratified by time window. There was no significant difference between groups (p=0.737). Loss to follow-up (19.6%) were replaced by imputed values. LSW, last seen well.

Mechanical thrombectomy beyond 6 hours in acute ischaemic stroke with large vessel occlusion in the carotid artery territory: experience at a tertiary hospital☆

E. Natera-Villalba[a,*], A. Cruz-Culebras[a], S. García-Madrona[a], R. Vera-Lechuga[a],

NEUROLOGÍA 2020

- 59 hasta…..%55.9 kadın; yaş ortalaması 71
- 33 olguda Uyanma İnmesi
- Medyan başlangıç NIHSS skoru 16
- Medyan ASPECTS skoru 8
- Hastaların %94.9'u kurtarılabilir doku nun > %50'sini gösteriyordu.
- Başlangıçtan 24 saat sonra MT uygulanan 5 hastanın %88.1'inde, kaydadeğer rekanalizasyon sağlandı.

Mechanical thrombectomy beyond 6 hours in acute ischaemic stroke with large vessel occlusion in the carotid artery territory: experience at a tertiary hospital☆

E. Natera-Villalba[a,*], A. Cruz-Culebras[a], S. García-Madrona[a], R. Vera-Lechuga[a],

NEUROLOGÍA 2020

Table 5 Logistic regression analysis of the variables showing a statistically significant association with poorer functional prognosis.

	OR	95% CI	P
Age	0.93	0.81-1.07	.317
Atrial fibrillation	0.12	0.004-2.82	.187
Baseline NIHSS score	0.72	0.47-1.12	.144
Puncture-to-recanalisation time	1.03	0.95-1.13	.455
NIHSS score at discharge	0.44	0.204-0.95	.036

Daha kötü prognoz ile ilişkili değişkenler

- Yaş
- Atriyal fibrilasyon
- Yüksek NIHSS skorları (Başvuru ve Taburculukta)
- Daha uzun ponksiyon-rekanalizasyon süresi

- 41 hastadan>>>>22 si MT işlemine alınmış
- Dahil edilme kriterleri
  - ASPECT >6
  - 6-24 saat aralığı
  - DWI lesion volume 70 mL veya az
  - Penumbra volume 15 mL veya daha fazla
  - Mismatch oranı 1.8 veya fazla
  - T max >10 sn olan Perfüzyon lezyon hacminin 100 mL den az olması

Table 2. Functional outcome of patients in our study compared to endovascular trials

	RIH study cohort	RIH study cohort & DEFUSE-2	HERMES cohort	Extend IA cohort
Good functional outcome (mRS 0-2)	14/22 (63.6%)	28/46 (60.8%)	291/633 (46.0%)	25/35 (71.0%)
Excellent functional outcome (mRS 0-1)	9/22 (40.9%)	N/A	170/633 (26.9%)	18/35 (51.0%)
Symptomatic hemorrhage	0/22 (0%)	N/A	28/634 (4.4%)	0/35 (0%)

- Mechanical Embolectomy for Acute Ischemic Stroke Beyond Six Hours from Symptom Onset Using MRI based perfusion imaging Ryan A. Et al. *Journal of the Neurological Sciences 2017*

Kollateral Değerlendirmeye göre hasta seçimi

- Akut inmeli hastalarda intrakraniyal kollateral dolaşımın penumbrayı koruduğu ve enfarktüs büyümesini sınırladığı bilinmektedir.

- BT anjiyografi, intrakraniyal kollaterallerin değerlendirilmesi için sıklıkla uygulanan invaziv olmayan bir yöntemdir.

Kollateral Değerlendirmeye göre hasta seçimi

- Günümüzde kollateral değerlendirmesinde kullanılan metodlar kalitatif ve semikantitatif metodlardır ve birbirlerine üstünlükleri kanıtlanmamıştır.

- Basitçe oklüzyon distalinde normal olan karşı tarafla aynı veya daha fazla, ya da orta serebral arter için vasküler sulama alanının %50'den fazlasında kollateral vasküler yapı varlığı 'iyi kollateral',

- Aksine distalde hiç vasküler yapı izlenmemesi ya da orta serebral arter için vasküler sulama alanının %50'den azında vasküler yapı olması distalde kötü kollateral akıma işaret eder

TAN Kollateral Skorlaması

- **0**: absent collateral supply to the occluded MCA territory
- **1**: collateral supply filling ≤50% but >0% of the occluded MCA territory
- **2**: collateral supply filling >50% but <100% of the occluded MCA territory
- **3**: 100% collateral supply of the occluded MCA territory

Collateral Circulation in Thrombectomy for Stroke After 6 to 24 Hours in the DAWN Trial

90 gün sonunda

Kollateral Durumu	mRS 0-2 arası
İyi	% 43.7
Zayıf	% 30.8
Kötü	% 17.7

Kollateral skorlaması.. BTA'da TAN skorlama
DSA'da ASITN grade ile yapılmış.
(American Society of Interventional and Therapeutic Neuroradiology collateral score)

David S.et al.
doi.org/10.1161/STROKEAHA.121.034471
Stroke. 2022;53:742–748

- **Role of modified TAN score in predicting prognosis in patients with acute ischemic stroke undergoing endovascular therapy**
- Recep Baydemir [1], Özlem Aykaç [2], Bilgehan Atılgan Acar [3], Zehra Uysal Kocabaş [4], Aysel Milanlioğlu [5], Ezgi Sezer Eryildiz [6], Atilla Özcan Özdemir [2] Clin Neurol Neurosurg 2021 Nov;210:106978

- 101 hasta çalışmaya dahil edilmiş
- % 50 sinde kötü kollateral saptanmış
- Kötü kollaterali olan bu hastaların
  - geliş NIHSS ve 24 saat sonraki NIHSS değerleri
  - Mortalite
  - Futil rekanalizasyon oranları …yüksek bulunmuş.
  - mRS ları düşük bulunmuş.

CT angiography collateral scoring: Correlation with DWI infarct size in proximal middle cerebral artery occlusion stroke within 12 h onset

Mahmoud M. Higazi *, Enas A. Abdel-Gawad

The Egyptian Journal of Radiology and Nuclear Medicine (2016) 47, 991–997

Table 1 Demographic, clinical and imaging data.

	All patients (n = 30)	CS ⩽ 50% (n = 14)	CS ⩾ 50% (n = 16)	p value
Age, y, median (IQR)	70 (55–83)	78 (68–83)	62 (52–80)	0.102
Sex, male, no. (%)	20 (67%)	9 (64%)	11 (69%)	
NIHSS, mean ± (SD)	13 ± (7)	17 ± (5)	9 ± (6)	**0.001**
Lag time, h, mean ± (SD)	5.34 ± (2.29)	5.96 ± (2.59)	5.03 ± (2.04)	0.448
DWI volume, mL, median (IQR)	24.317 (14.049–117.747)	119.381 (28.556–154.470)	15.4590 (12.772–24.318)	**0.009**

IQR: interquartile range and SD: standard deviation.

- Kollateral skorlaması < % 50 ise
  - DWI volume ortalama = 119
  - NIHSS ortalama=17
- Kollateral skorlaması > % 50 ise
  - DWI volume ortalama=15
  - NIHSS ortalama=17

Extending thrombolysis to 4·5–9 h and wake-up stroke using perfusion imaging: a systematic review and meta-analysis of individual patient data

Bruce C V Campbell, Henry Ma*, Peter A Ringleb*, Mark W Parsons, Leonid Churilov, Martin Bendszus, Christopher R Levi, Chung Hsu, Timothy J Kleinig, Marc Fatar, Didier Leys, Carlos Molina, Tissa Wijeratne, Sami Curtze, Helen M Dewey, P Alan Barber, Kenneth S Butcher, Deidre A De Silva, Christopher F Bladin, Nawaf Yassi, Johannes A R Pfaff, Gagan Sharma, Andrew Bivard, Patricia M Desmond, Stefan Schwab, Peter D Schellinger, Bernard Yan, Peter J Mitchell, Joaquín Serena, Danilo Toni, Vincent Thijs, Werner Hacke†, Stephen M Davis†, Geoffrey A Donnan†, on behalf of the EXTEND, ECASS-4, and EPITHET Investigators‡*

Findings We identified three trials that met eligibility criteria: EXTEND, ECASS4-EXTEND, and EPITHET. Of the 414 patients included in the three trials, 213 (51%) were assigned to receive alteplase and 201 (49%) were assigned to receive placebo. Overall, 211 patients in the alteplase group and 199 patients in the placebo group had mRS assessment data at 3 months and thus were included in the analysis of the primary outcome. 76 (36%) of 211 patients in the alteplase group and 58 (29%) of 199 patients in the placebo group had achieved excellent functional outcome at 3 months (adjusted odds ratio [OR] 1·86, 95% CI 1·15–2·99, p=0·011). Symptomatic intracerebral haemorrhage was more common in the alteplase group than the placebo group (ten [5%] of 213 patients *vs* one [<1%] of 201 patients in the placebo group; adjusted OR 9·7, 95% CI 1·23–76·55, p=0·031). 29 (14%) of 213 patients in the alteplase group and 18 (9%) of 201 patients in the placebo group died (adjusted OR 1·55, 0·81–2·96, p=0·66).

Interpretation Patients with ischaemic stroke 4·5–9 h from stroke onset or wake-up stroke with salvageable brain tissue who were treated with alteplase achieved better functional outcomes than did patients given placebo. The rate of symptomatic intracerebral haemorrhage was higher with alteplase, but this increase did not negate the overall net benefit of thrombolysis.

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	Placebo (n=201)	Alteplase (n=213)	Odds ratio* (95% CI)	p value
Primary outcome				
Excellent functional outcome (mRS score 0–1) at 3 months	58/199 (29%)	76/211 (36%)	1·86 (1·15–2·99)	0·01
Secondary outcomes				
Functional improvement in mRS score at 3 months†	NA	NA	1·60 (1·12–2·27)	0·009
Functional independence (mRS score 0–2) at 3 months	87/199 (44%)	103/211 (49%)	1·74 (1·08–2·81)	0·02
Early neurological improvement at 72 h‡	31/197 (16%)	58/206 (28%)	2·54 (1·51–4·27)	<0·0001
Safety outcomes				
Death at 3 months	18/201 (9%)	29/213 (14%)	1·55 (0·81–2·97)	0·19
Symptomatic intracerebral haemorrhage§	1/201 (<1%)	10/213 (5%)	9·70 (1·23–76·55)	0·03

Tenecteplase in Stroke Patients Between 4.5 and 24 Hours (TIMELESS)

- Actual Study Start Date : March 2, 2019
- Estimated Primary Completion Date : September 1, 2022
- Estimated Study Completion Date : September 1, 2022

Tenecteplase in Stroke Patients Between 4.5 and 24 Hours (TIMELESS)

- Nörogörüntüleme:
- Manyetik rezonans anjiyografi (MRA)
- veya bilgisayarlı tomografi anjiyografi (BTA)
  - ile ICA veya M1, M2 oklüzyonu (karotis oklüzyonları servikal veya intrakraniyal olabilir, tandem MCA lezyonları olsun veya olmasın)

BT perfüzyon veya MR perfüzyonda
İskemik kor hacmi <70 mL,
mismatch oranı >=1.8 ve
Mismatch hacmi >= 15 mL)

- Geç Başvuran İnme (GBİ) ve Uyanma İnmeli (Uİ) hastalarda EVT gerekliliği için daha basit ve daha hızlı protokoller gerekliliği aşikardır.

- Ancak, bu hastaları seçmek için en uygun görüntüleme protokolü hala tartışma konusudur.

  - Barber PA, Hill MD, Eliasziw M, et al. Imaging of the brain in acute ischaemic stroke: comparison of computed tomography and magnetic resonance diffusion-weighted imaging. J Neurol Neurosurg Psychiatry 2005;76:1528–33.

  - von Kummer R, Bourquain H, Bastianello S, et al. Early prediction of irreversible brain damage after ischemic stroke at CT. Radiology 2001;219:95–100.

6 saat Sonrası İnme ve Uyanma İnmelerinde vaka Seçiminde -ÖZETLE -DİKKAT EDİLECEK HUSUSLAR

- BT'de hipodansite olmaması
- Normal veya normale yakın BT bulguları olan hastada BT anjiyografide majör damar/dal oklüzyonu olması
- BT perfüzyon yapılan olgularda hipo-perfüze alanının geniş ama hipodansitenin küçük olması

- MCA sulama alanının %50'den fazlasında kollateral vasküler yapı varlığı 'iyi kollateral olması
- DWI lezyon hacminin 70 mL veya az olması
- Penumbra volume 15 mL veya daha fazla olması
- DWI/FLAIR mismatch olması

Teşekkürler