

XVII CURSO NACIONAL DE NEURORRADIOLOGÍA

Neurorradiología en la Patología Vascular Cerebral

EDICIÓN VIRTUAL

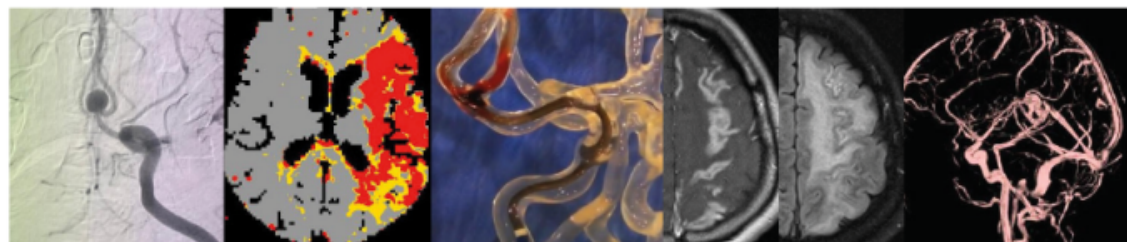
22-26 febrero 2021

**Código ictus:
Selección de pacientes para terapia trombolítica.
Papel de la Neuroimagen**

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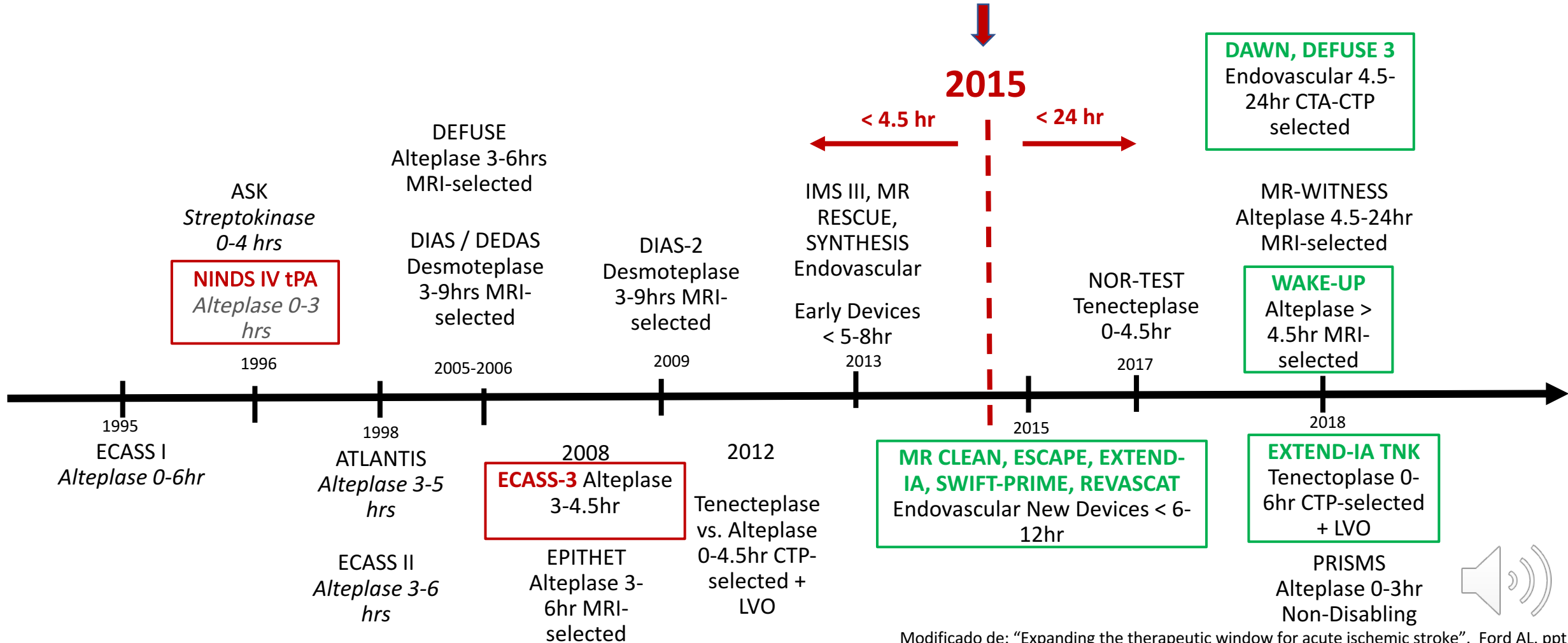


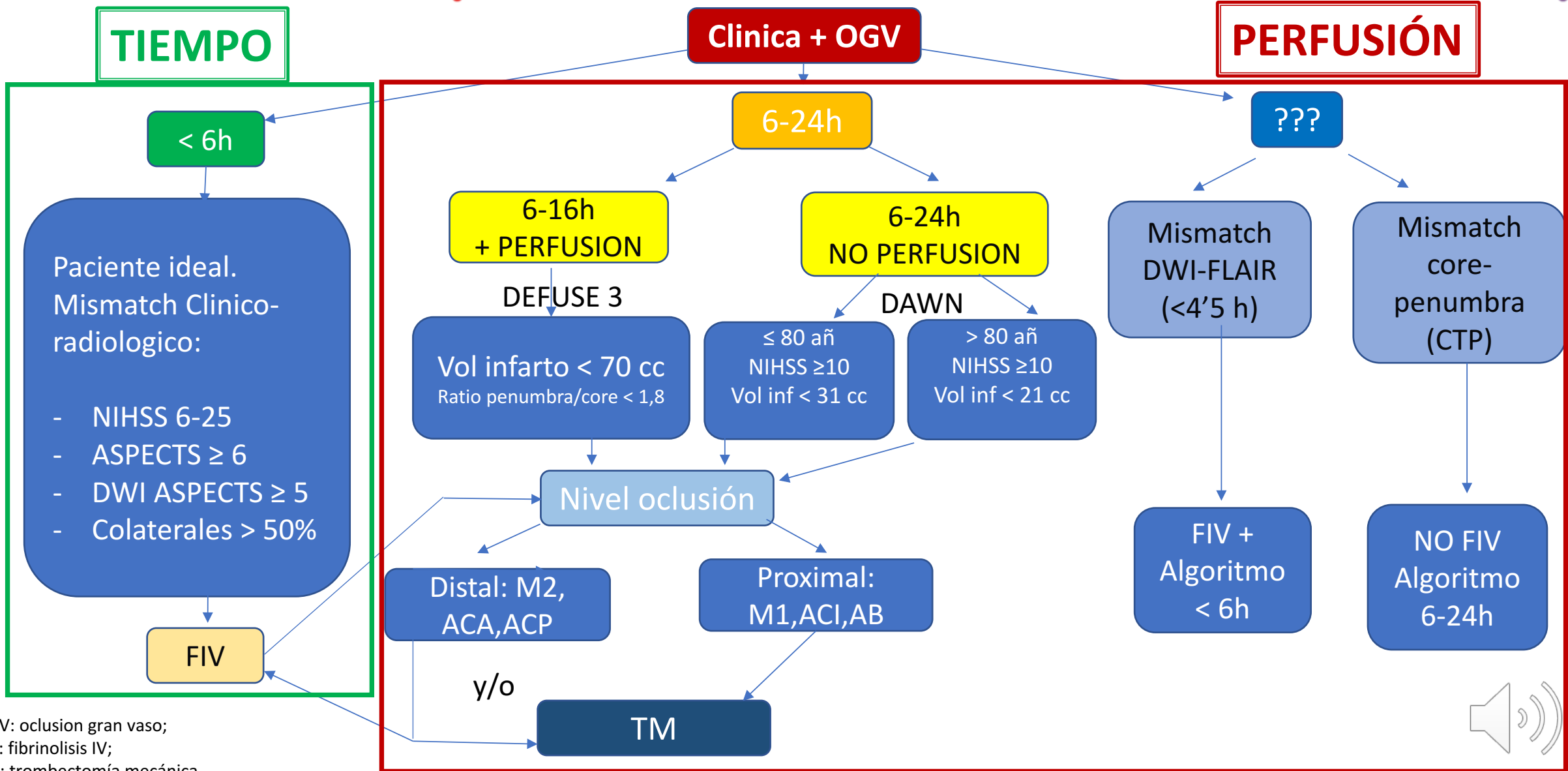
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Terapia Endovascular

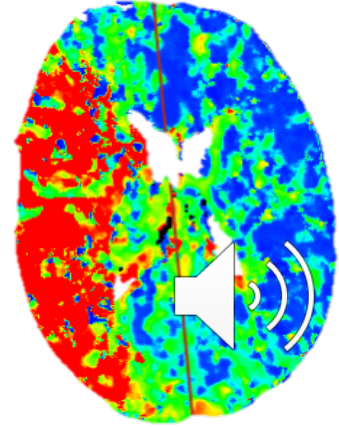
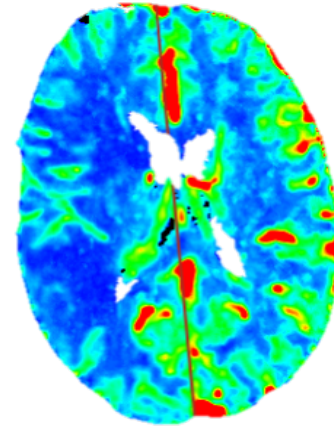
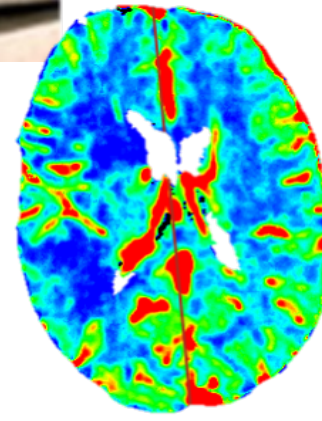
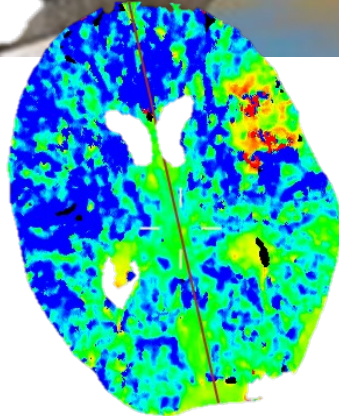
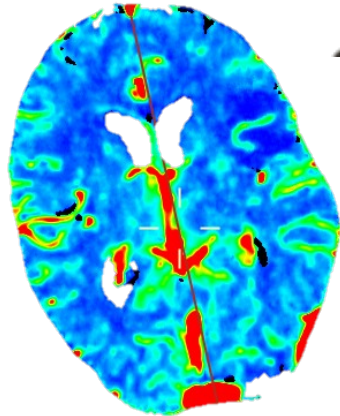
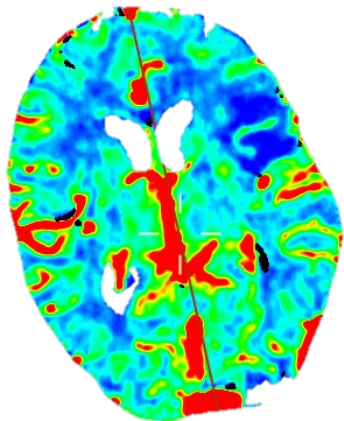
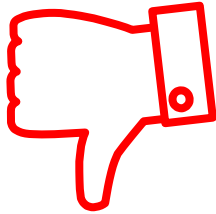
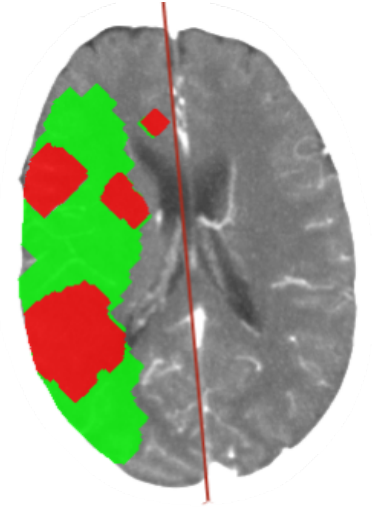
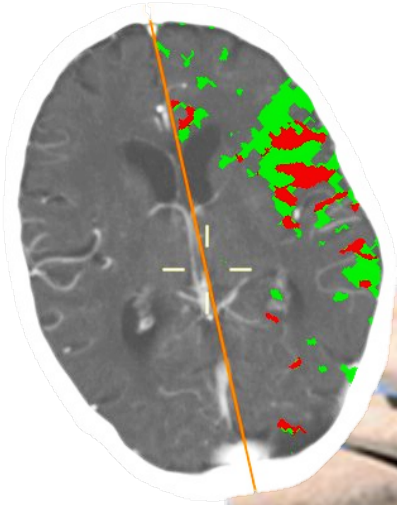




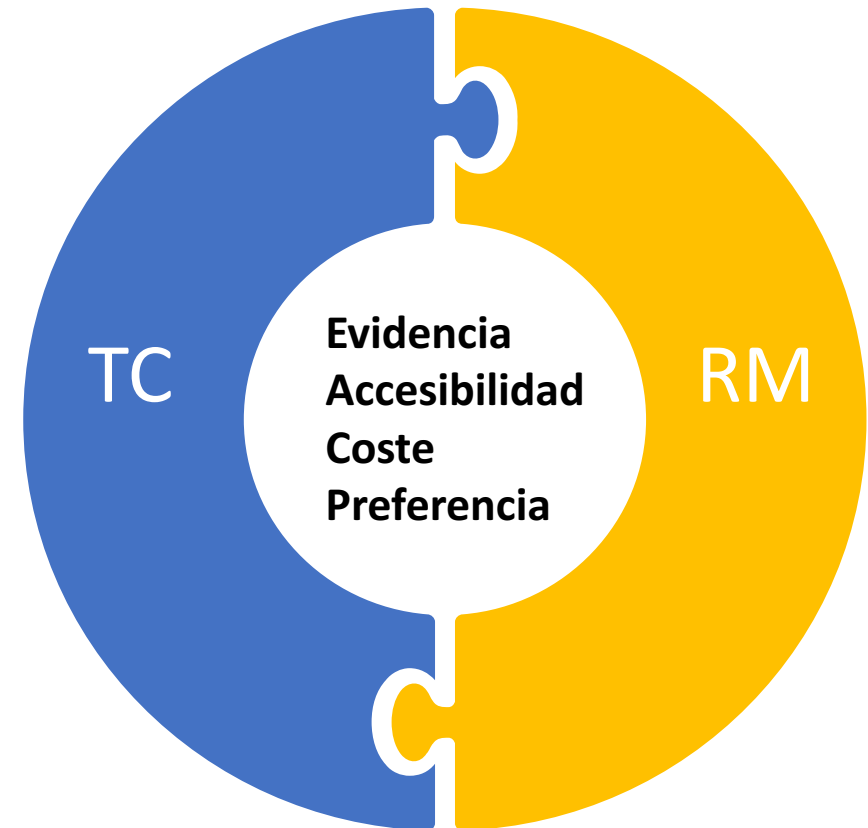
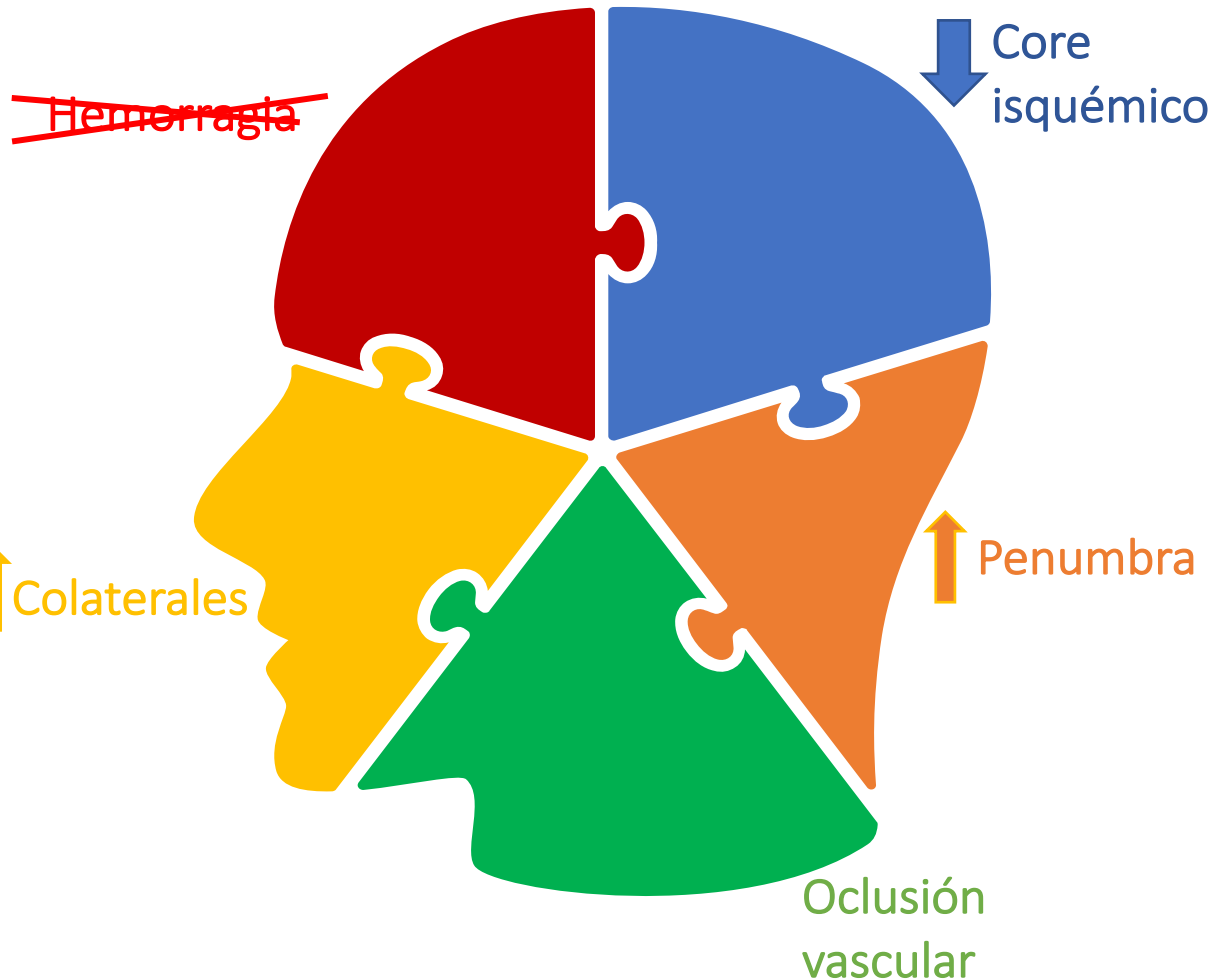
OGV: oclusion gran vaso;
 FIV: fibrinolis IV;
 TM: trombectomía mecánica



NEUROIMAGEN
MULTIMODAL



¿La información es realmente necesaria? El Neuroimagen en el diagnóstico empleado?



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.

When evaluating patients with AIS within 6 hours of last known normal with LVO and an Alberta Stroke Program Early Computed Tomography Score (ASPECTS) of ≥ 6 , selection for mechanical thrombectomy based on CT and CTA or MRI and MRA is recommended in preference to performance of additional imaging such as perfusion studies.

For otherwise eligible patients with mild disabling stroke symptoms, IV alteplase may be reasonable for patients who can be treated within 3 and 4.5 hours of ischemic stroke symptom onset or patient last known well or at baseline state.

For otherwise eligible patients with mild nondisabling stroke symptoms (NIHSS score 0–5), IV alteplase is not recommended for patients who could be treated within 3 hours of ischemic stroke symptom onset or patient last known well or at baseline state.

For otherwise eligible patients with mild non-disabling stroke symptoms (NIHSS 0–5), IV alteplase is not recommended for patients who could be treated within 3 and 4.5 hours of ischemic stroke symptom onset or patient last known well or at baseline state.

In patients with a hyperdense MCA sign, IV alteplase can be beneficial.

I	A	New recommendation.
I	B-NR	New recommendation.
IIb	B-NR	New recommendation.
III: No Benefit	B-R	New recommendation.
III: No Benefit	C-LD	New recommendation.
IIa	B-NR	New recommendation.



Telestroke/teleradiology evaluations of AIS patients can be effective for correct IV alteplase eligibility decision making.

Establishing and monitoring target time goals for ED door-to-treatment IV fibrinolysis time can be beneficial to monitor and enhance system performance.

Systems should be established so that brain imaging studies can be performed as quickly as possible in patients who may be candidates for IV fibrinolysis or mechanical thrombectomy or both.

CTA with CTP or MR angiography (MRA) with diffusion-weighted magnetic resonance imaging (DW-MRI) with or without MR perfusion is recommended for certain patients.

In patients eligible for IV alteplase, because benefit of therapy is time dependent, treatment should be initiated as quickly as possible and not delayed for additional multimodal neuroimaging, such as CT and MRI perfusion imaging.

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.

In patients with suspected intracranial LVO and no history of renal impairment, who otherwise meet criteria for mechanical thrombectomy, it is reasonable to proceed with CTA if indicated before obtaining a serum creatinine concentration.

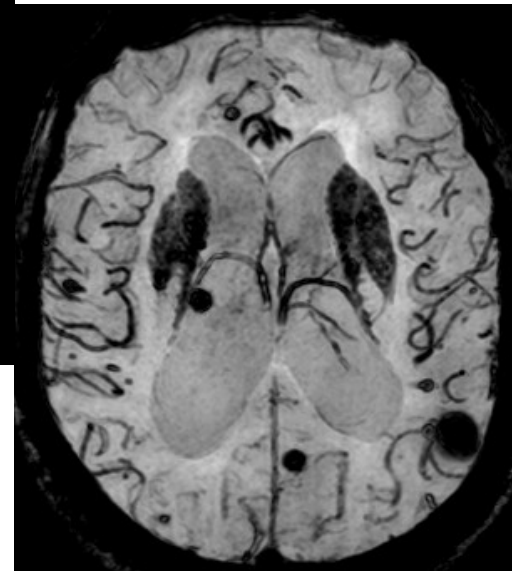
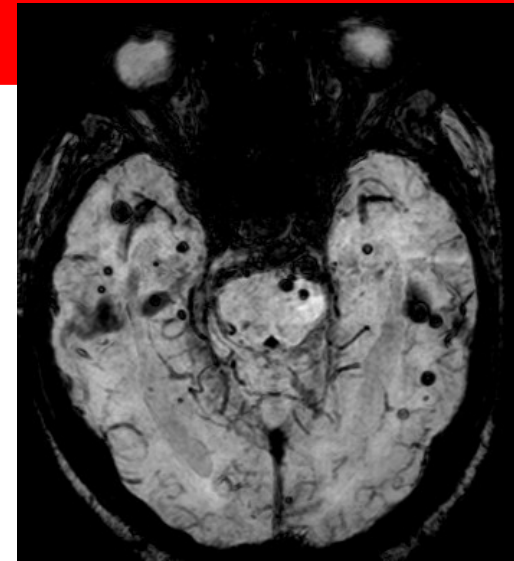
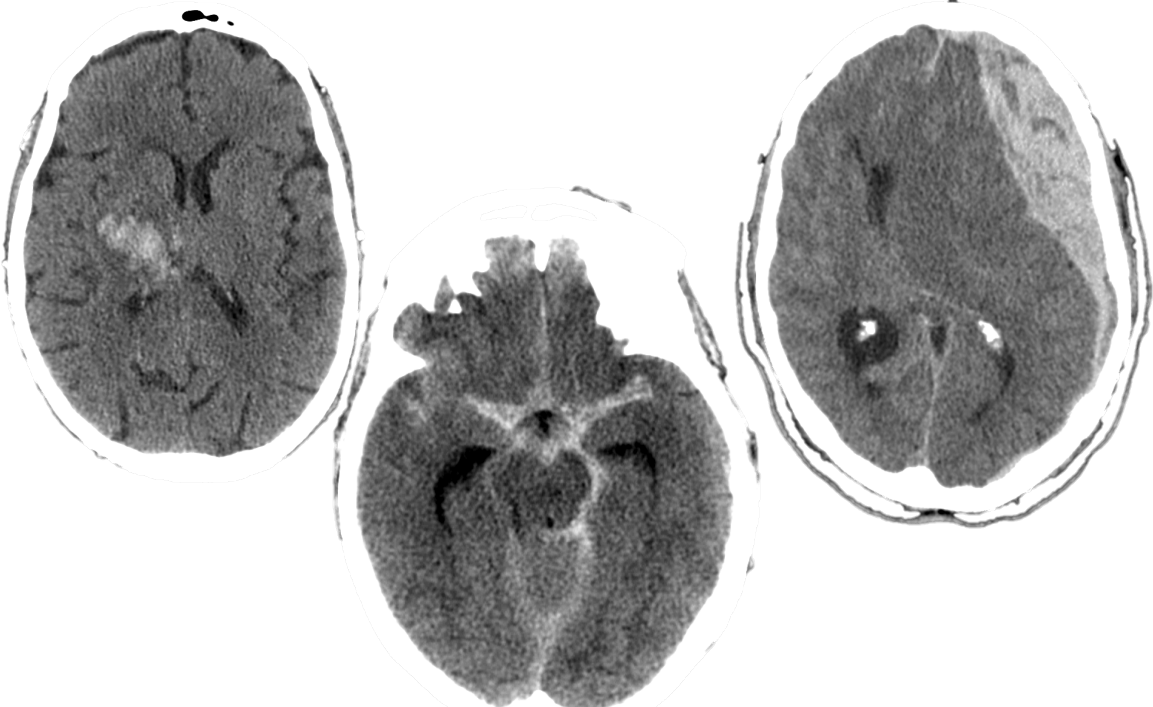
In patients who are potential candidates for mechanical thrombectomy, imaging of the extracranial carotid and vertebral arteries, in addition to the intracranial circulation, may be reasonable to provide useful information on patient eligibility and endovascular procedural planning.

IIa	B-R	New recommendation.
I	B-NR	New recommendation.
I	B-NR	New recommendation.
I	A	New recommendation.
I	B-NR	New recommendation.
IIa	B-R	New recommendation.
IIa	B-NR	New recommendation.
IIb	C-EO	New recommendation.





TC BASAL ➔ HEMORRAGIA



Administration of IV alteplase in eligible patients without first obtaining MRI to exclude cerebral microbleeds (CMBs) is recommended.

In otherwise eligible patients who have previously had a small number (1–10) of CMBs demonstrated on MRI, administration of IV alteplase is reasonable.

In otherwise eligible patients who have previously had a high burden of CMBs (>10) demonstrated on MRI, treatment with IV alteplase may be associated with an increased risk of sICH, and the benefits of treatment are uncertain. Treatment may be reasonable if there is the potential for substantial benefit.

I	B-NR	New recommendation.
IIa	B-NR	New recommendation.
IIb	B-NR	New recommendation.



TC BASAL ➔ CORE ISQUÉMICO



Core Isquémico: afuncional. No recuperable

aCBF < 10 ml/100 gr/ min

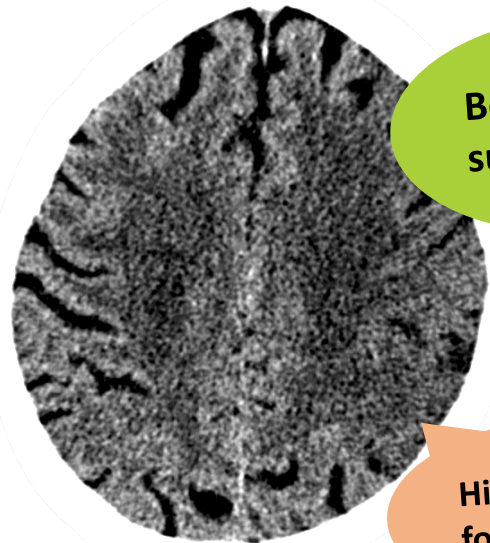
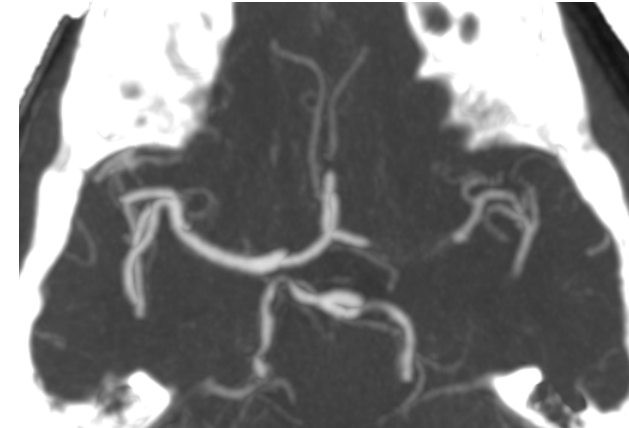
CTP/MRP: ↓↓ CBF ↓↓ CBV ↑ MTT/Tmax

Penumbra: en riesgo. Recuperable

Oligoemia benigna: funcional. No reclutable en el core

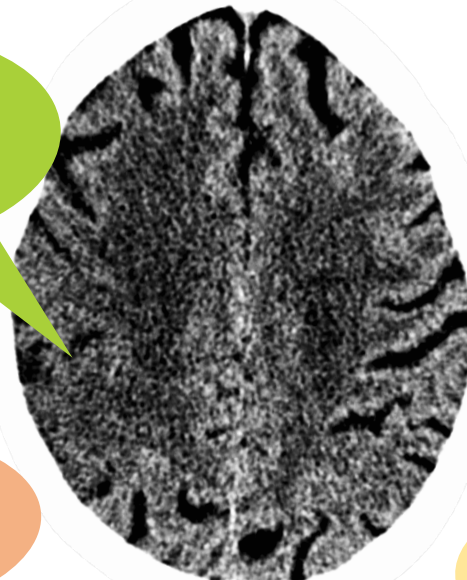


TC BASAL ➤ CORE ISQUÉMICO ➤ SIGNOS PRECOZES

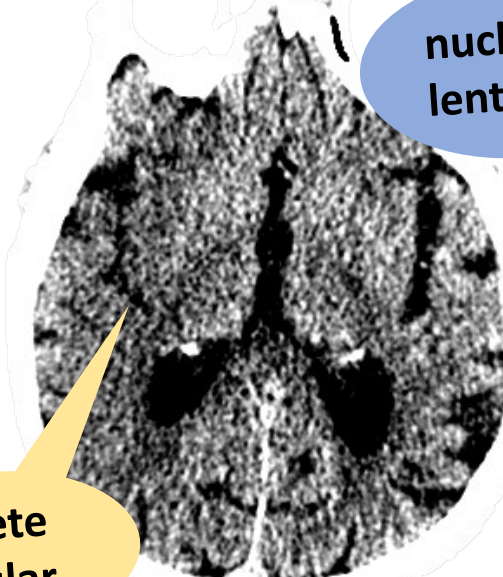


Borramiento
surcos

Hipodensidad
focal



Ribete
insular

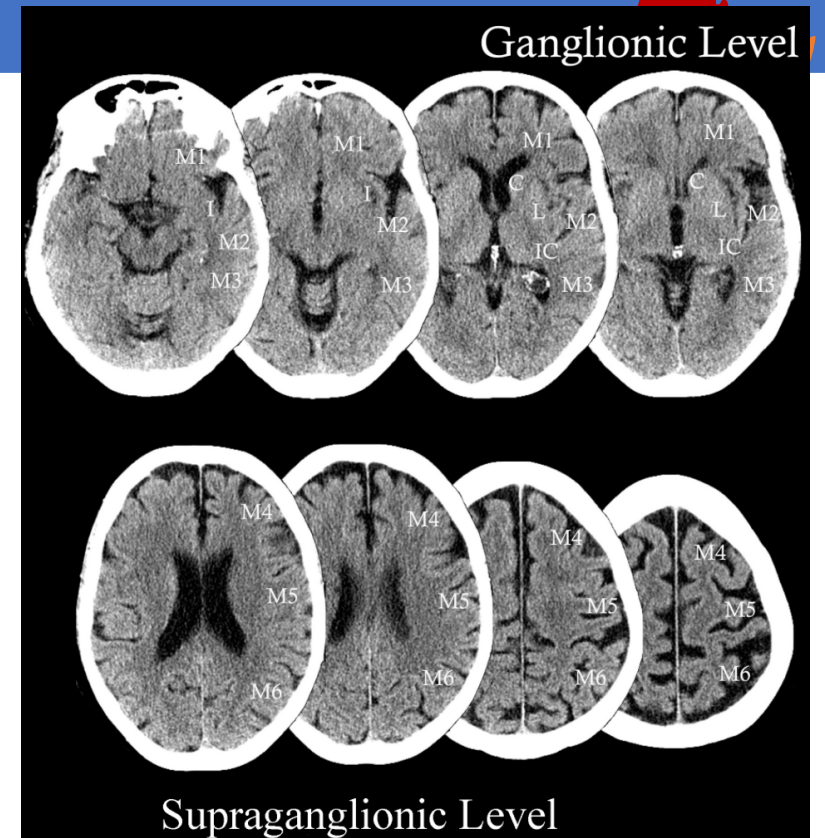


nucleo
lenticular



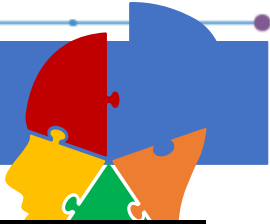
TC BASAL ➤ CORE ISQUÉMICO ➤ ASPECTS

- 10 regiones (ACM)
- 2 Niveles
 - Ganglionar y supraganglionar con límite en la cabeza del núcleo caudado
- PUNTÚA.
 - SOLO hipodensidad y/o pérdida de diferenciación sustancia gris-blanca.
- NO PUNTÚA.
 - Vaso hiperdenso, borramiento de surcos.
 - Si plantea dudas.
 - Focos de isquemia crónica.

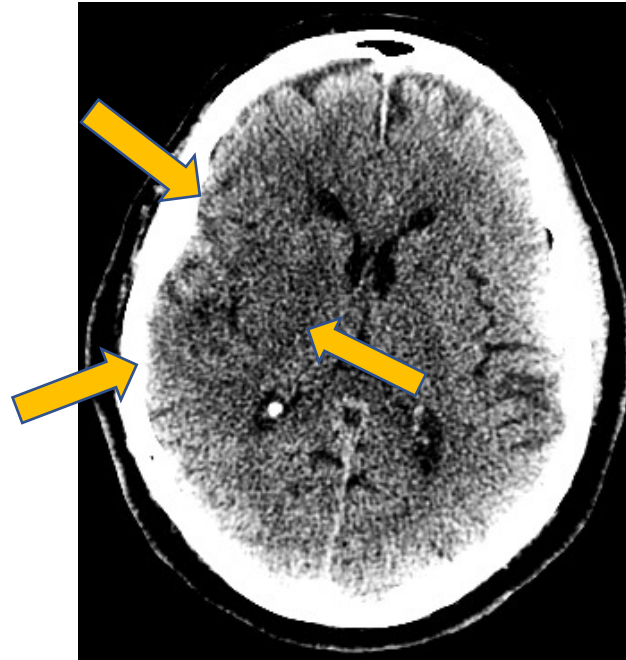


M1-M6: Territorios corticales
C: Caudado
L: Lenticular
I: Ínsula
CI: Brazo posterior de cápsula interna

TC BASAL ➤ CORE ISQUÉMICO ➤ ASPECTS



- **ASPECTS 0-3:** No candidatos a tratamiento de rescate endovascular ni fibrinolisis.



- **ASPECTS 4-5:** Tratamiento no indicado de forma sistemática. Pueden beneficiarse de evaluación individualizada mediante TC perfusión



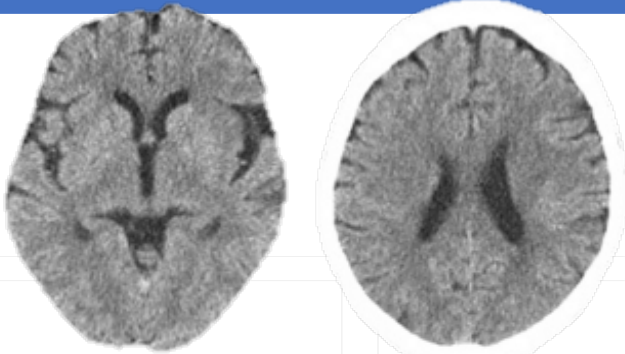
- **ASPECTS 6-10:** Buen resultado del tratamiento.



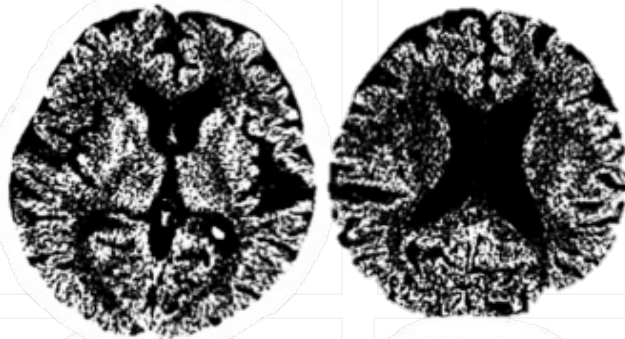
TC BASAL ➤ CORE ISQUÉMICO ➤ ASPECTS



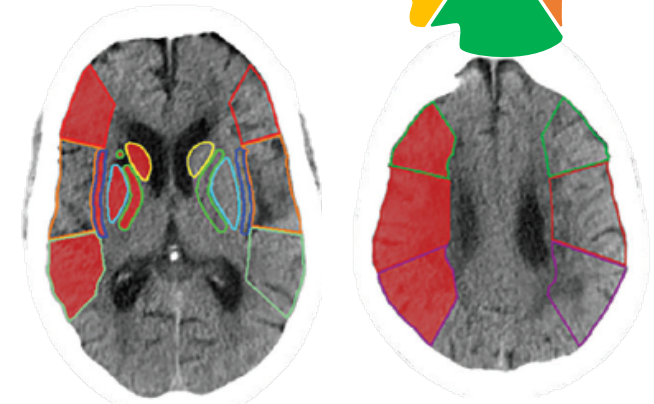
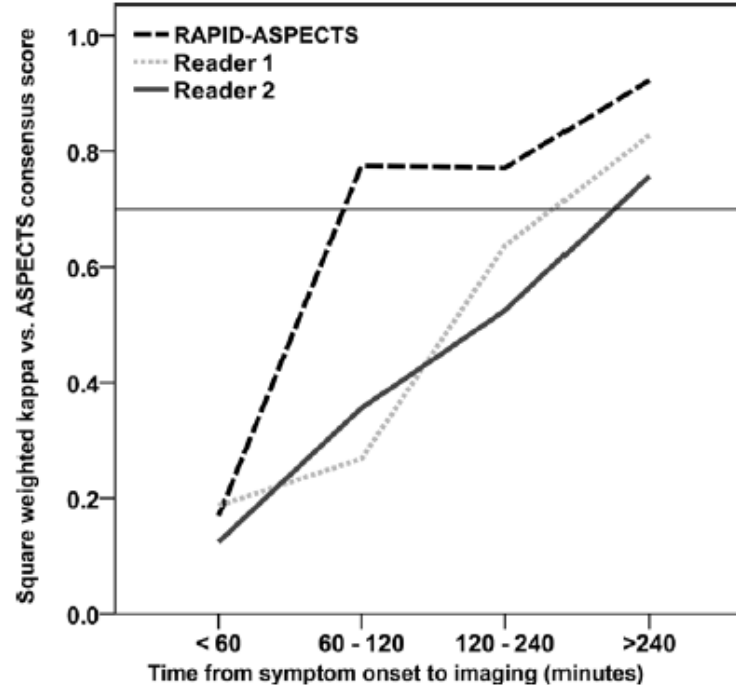
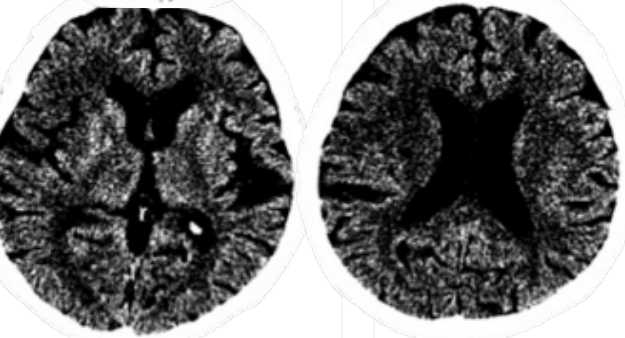
80UH W- 20 UH L



8UH W – 32UH L



20UH W – 35 UH L



- Concordancia moderada (0,57-0,56) entre neurorradiólogos expertos y ASPECTS de consenso
- Concordancia alta (0,9) entre RAPID y ASPECTS de consenso



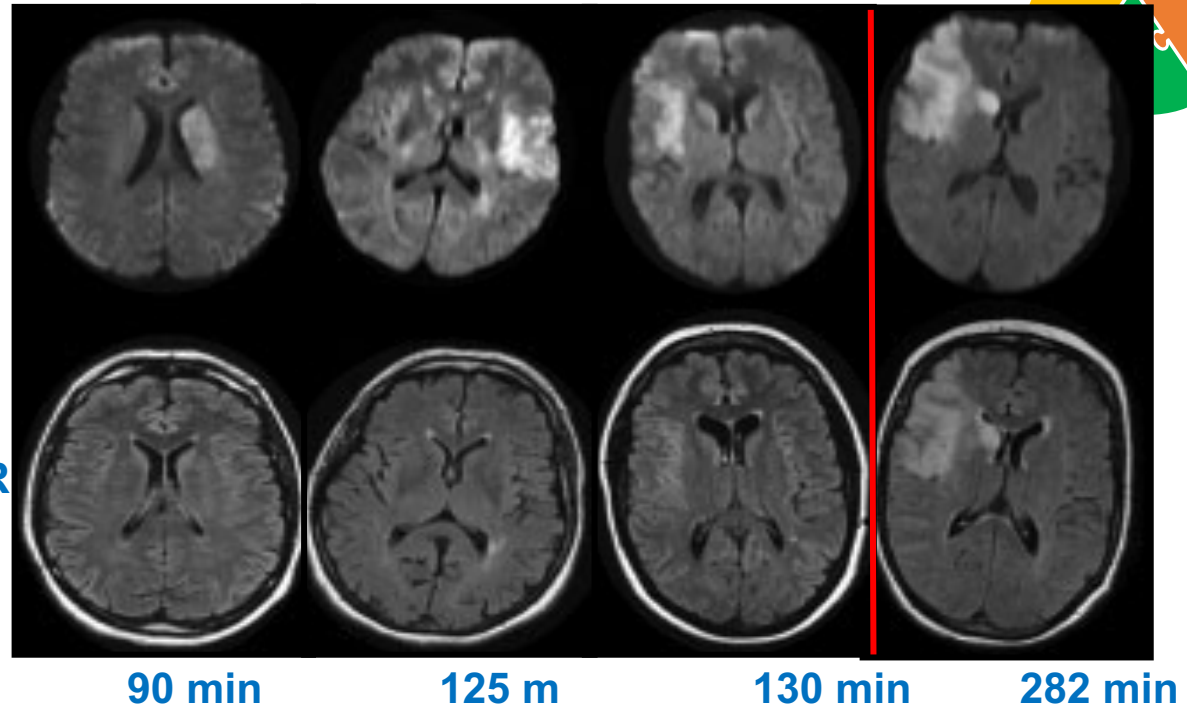
RM → CORE ISQUÉMICO

< 4'5 h

- DWI: b=2000, 1'5T.
- DWI-ASPECTS (SWIFT ≥ 5)
- Volumetría del core (SWIFT, EXTEND-IA < 50-70 ml; DAWN: 21-31 ml)
- FLAIR: “reloj tisular” en ictus del despertar o inicio incierto (1'5T). Mismatch DWI-FLAIR

DWI

FLAIR



90 min

125 m

130 min

282 min

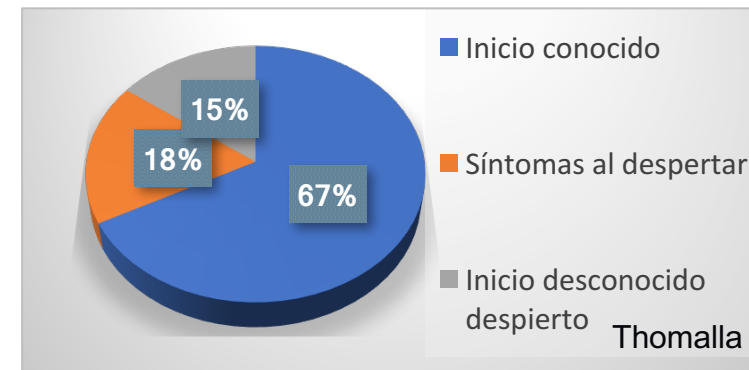
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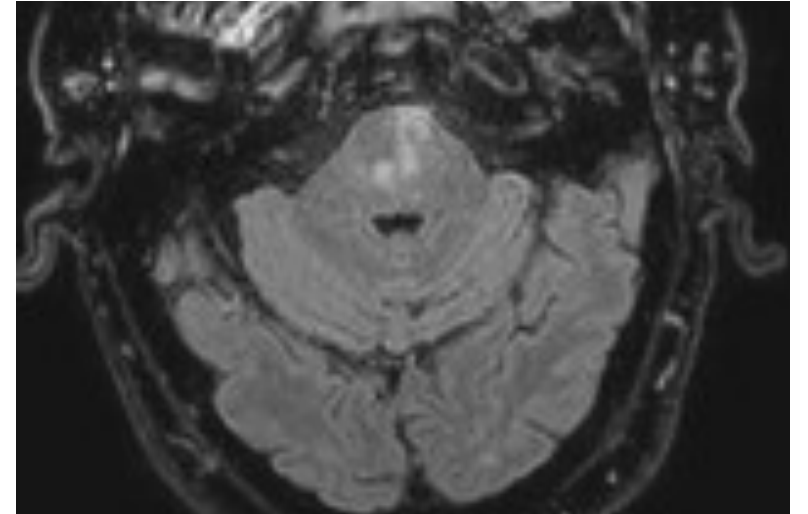
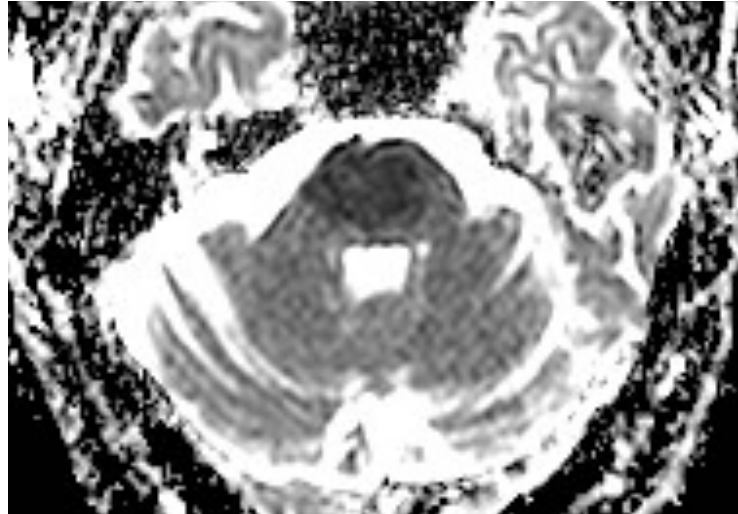
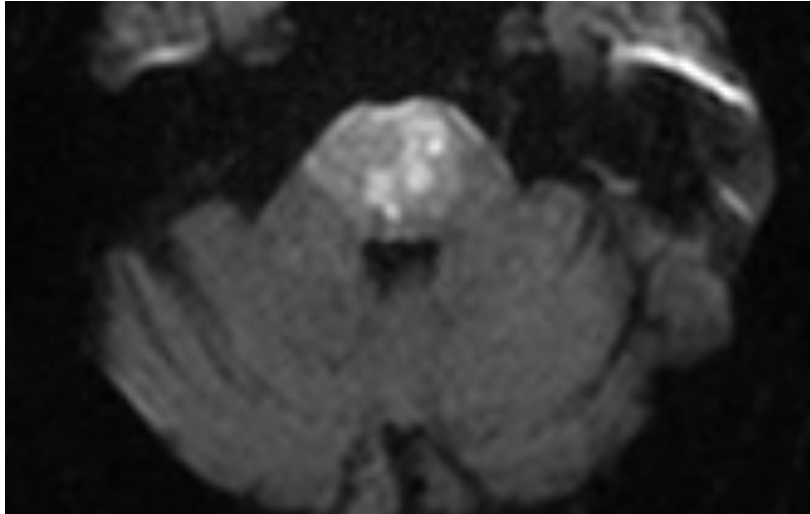
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I	A
IIa	B-R

New recommendation.

New recommendation.

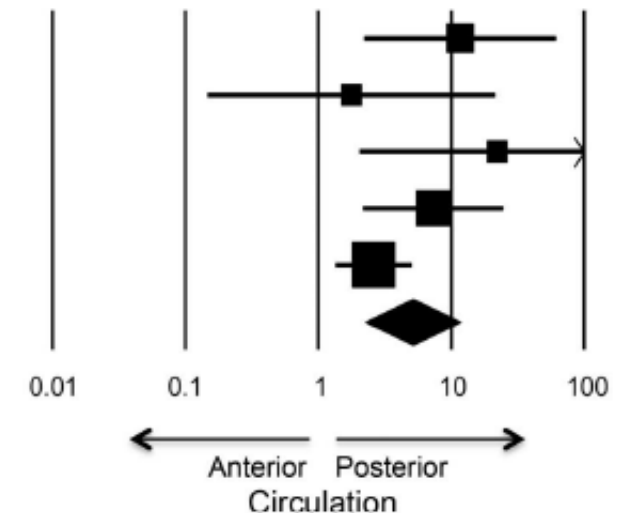




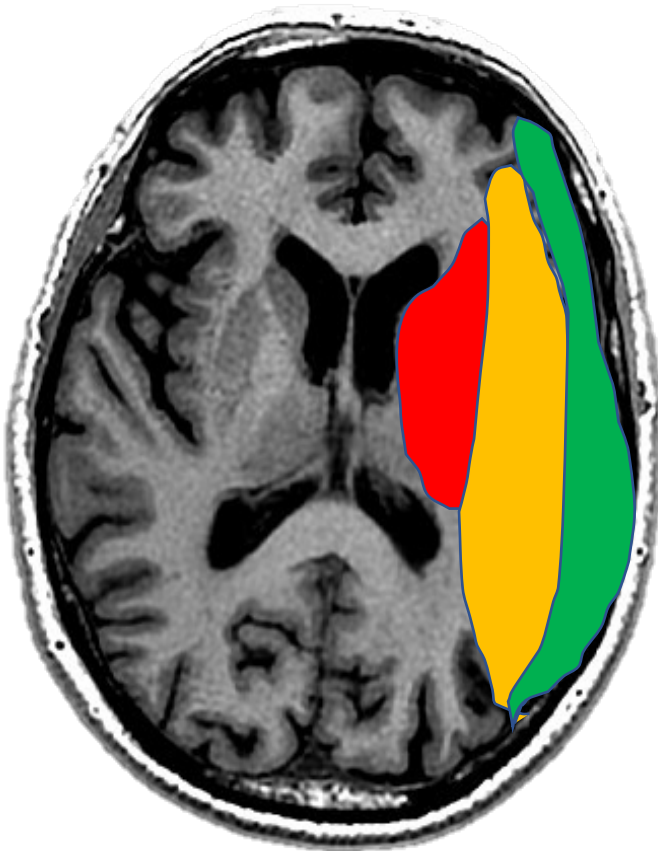
ICTUS AGUDO Y DWI NEGATIVA

- Meta-análisis Pubmed/Ovid/Medline 1992-2016 (1132 estudios).
- Inclusión: pacientes con diagnóstico clínico de ictus agudo y DWI en las primeras 72h → DWI negativa
- 12 estudios; 3236 pac (8 de ellos previos a 2005).
- 231 pac. con ictus agudo y DWI negativa (6,8%).
- OR circ posterior/circ anterior= 5,1 (p=0,0005).
- En el ictus agudo debe prevalecer el diagnóstico clínico y no excluir a ningún paciente de tratamiento en base a una DWI negativa.

Study	n	OR	95% CI	p
Ref #24 (2000A)	130	11.6	2.2, 61.2	0.004
Ref #26 (2000B)	59	1.8	0.1, 21.4	0.652
Ref #e2 (2001)	79	22.1	2.0, 239.2	0.011
Ref #11 (2007)	190	7.3	2.2, 25.0	0.001
Ref #7 (2015)	565	2.6	1.3, 5.0	0.004
Total	1,023	5.1	2.3, 11.6	<0.001



TCP/RMP ➤ PENUMBRA ISQUÉMICA



“Tejido isquémico en riesgo”

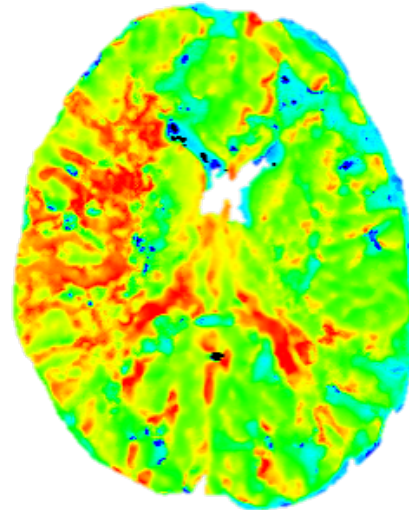
Core Isquémico: aCBF < 10 ml/100 gr/ min
CTP/MRP: ↓↓ CBF ↓↓ CBV ↑ MTT/Tmax

Penumbra: aCBF = 10-22 ml/100gr/min
CTP/MRP: ↓ CBF, = CBV, ↑ MTT/Tmax
Tmax > 6 sg
MTT > 145% del contralateral

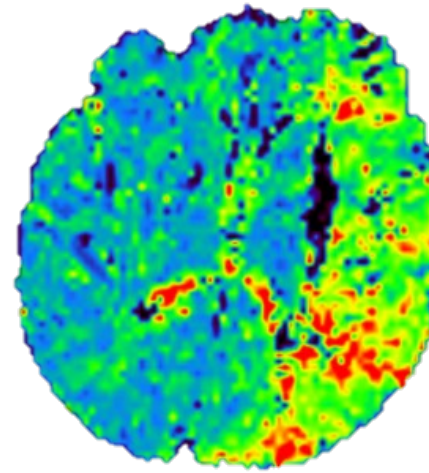
Oligoemia benigna: CTP/MRP: ↓/ = CBF, = CBV, ↑ MTT/Tmax
CTP: aCBF > 20ml/100gr/min



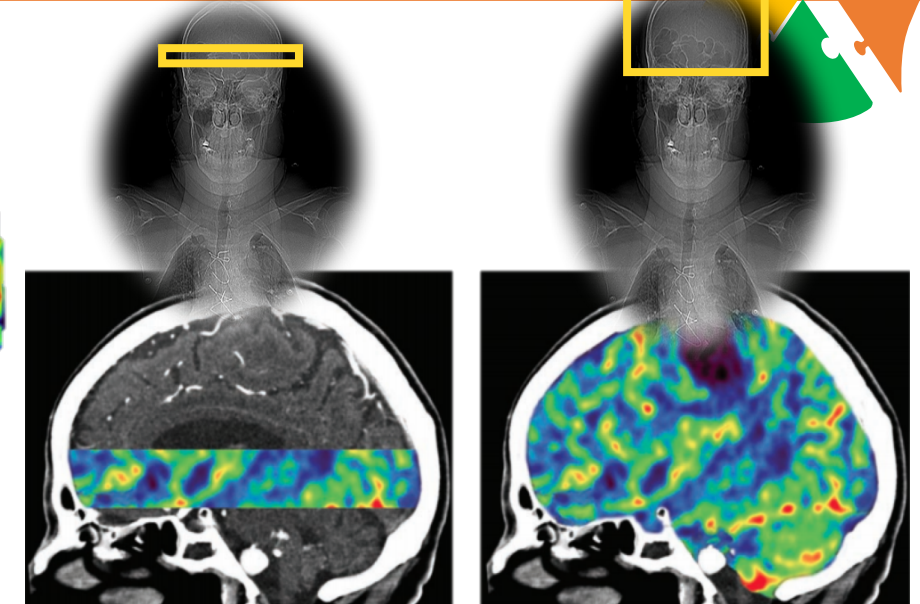
TCP/RMP ➔ PENUMBRA ISQUÉMICA



TCP

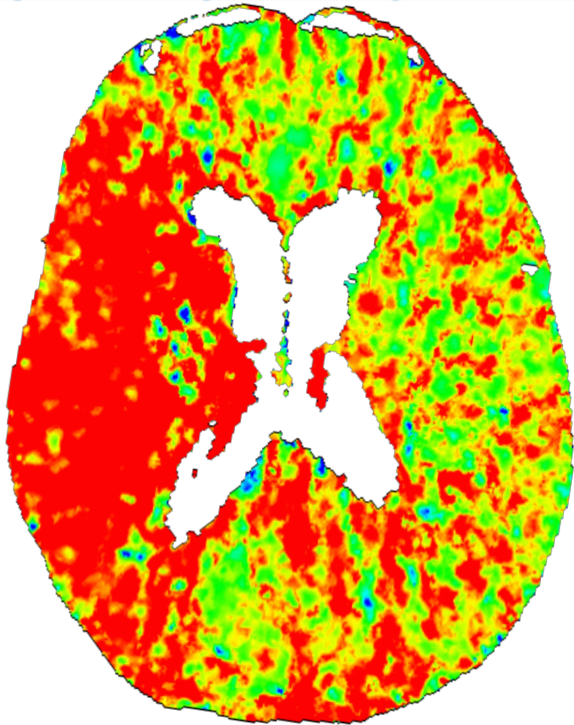


RMP



- Indicación ictus de circulación anterior:
 - Ictus de > 6 horas de evolución
 - Ictus de tiempo de evolución desconocido o del despertar
 - Excepcionalmente en pacientes con ASPECTS limítrofes para valorar beneficio potencial de trombectomía
- ¿Circulación posterior?

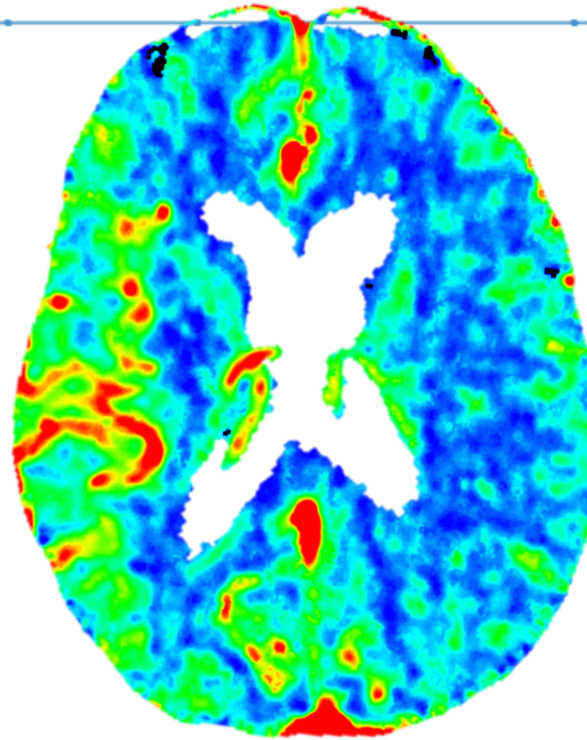




TTM

Tiempo medio que tarda la sangre en llegar por la arteria e irse por completo por la vena

Delimita el territorio en isquemia aguda

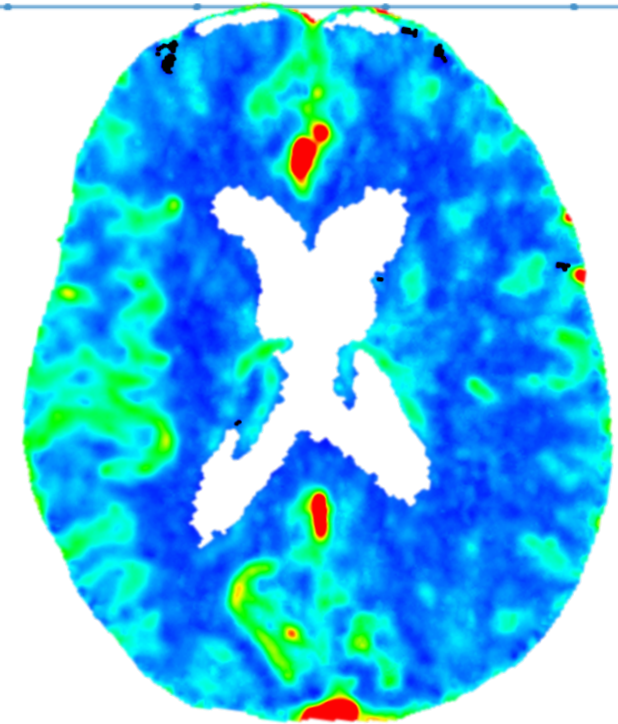


VSC

Cantidad de sangre por unidad de tejido

Diferencia:

Infarto: Caída de VSC
Penumbra: VSC normal o aumentado



FSC

Cantidad de sangre por unidad de tejido y tiempo

Clasifica las áreas de isquemia

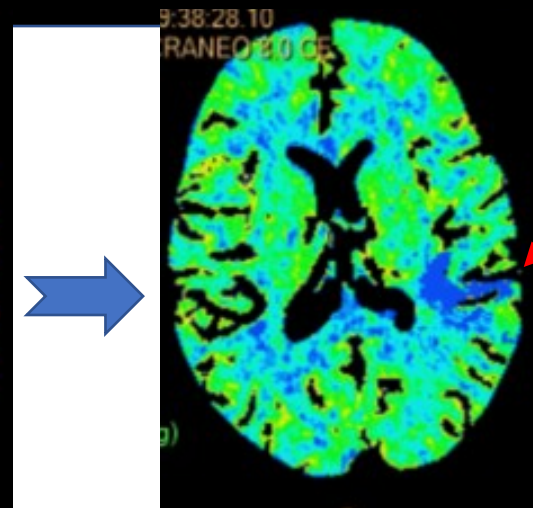
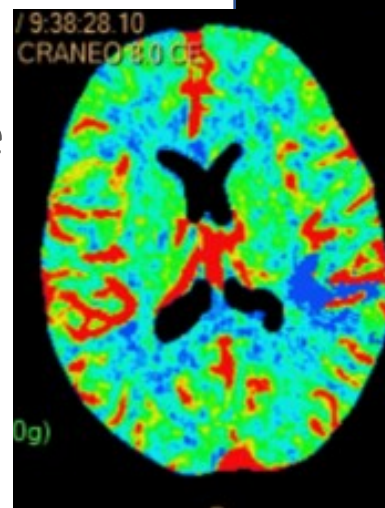
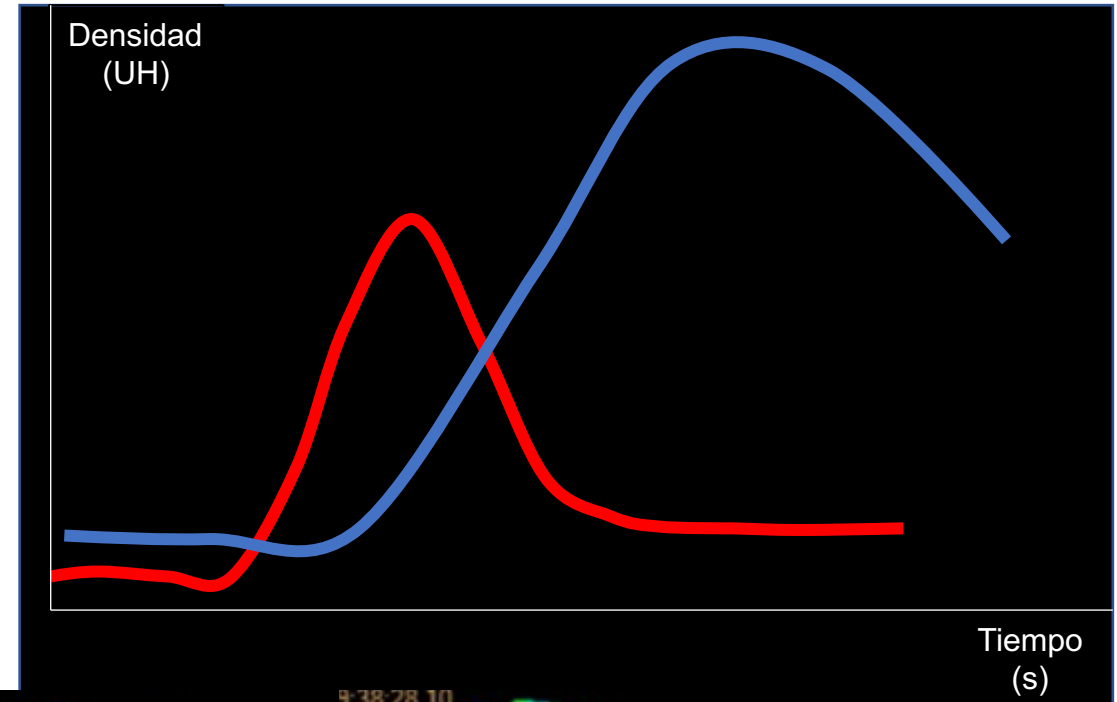


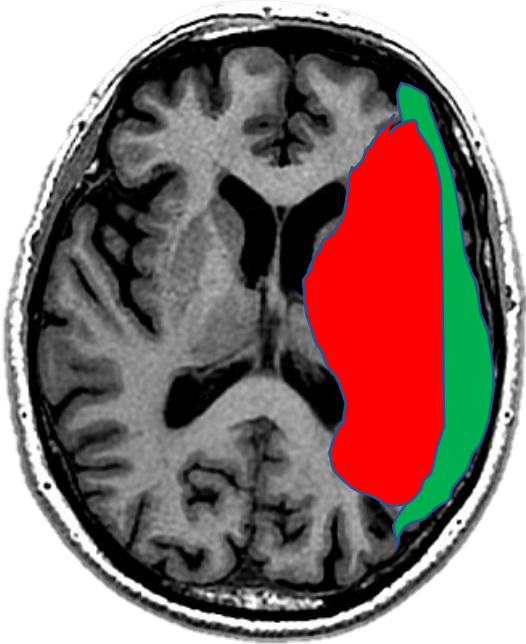
FALSO POSITIVO:

- Baja intensidad del bolo de contraste
- Microangiopatía de la sustancia blanca
- Acortamiento del tiempo de adquisición (del tránsito del bolo de contraste):
 - evitar sobreirradiación
 - bajo gasto cardiaco

FALSO NEGATIVO:

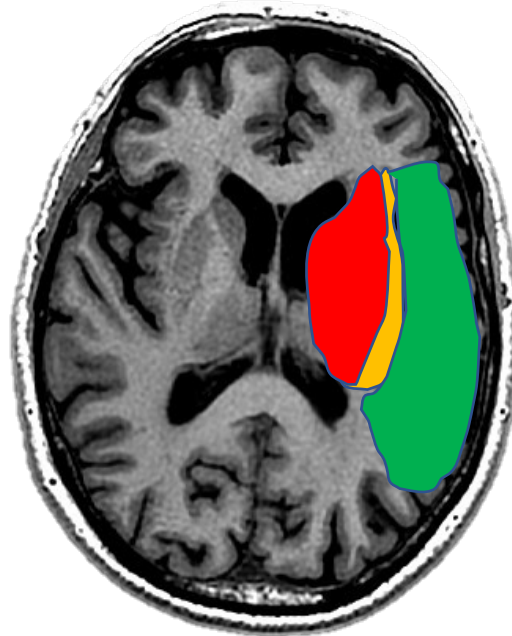
- Volumen parcial adyacente a vasos de gran calibre





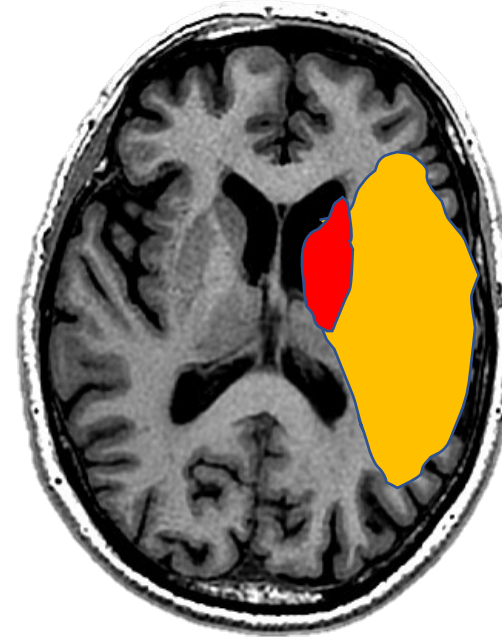
INFARTO MALIGNO

- ++ core (> 100 ml)
- No penumbra
- No mismatch
- Oligoemia insignificante



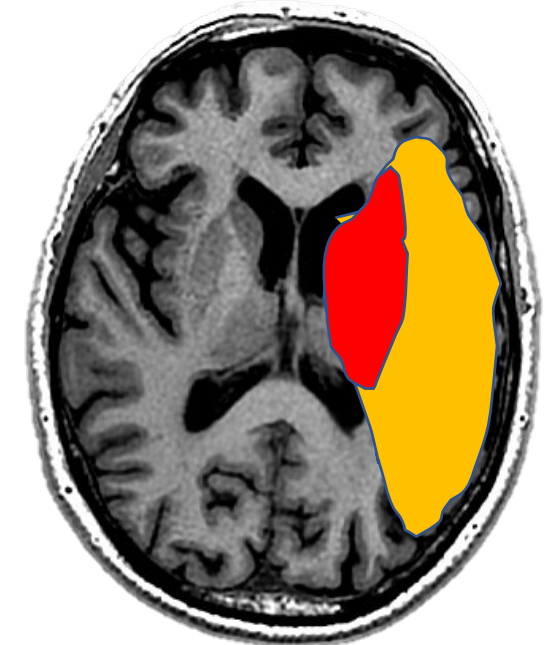
NO MISMATCH

- + core (50-100)
- Penumbra = core
- No mismatch



CORE PEQUEÑO

- --core (< 10 ml)
- ++ penumbra
- ++ mismatch

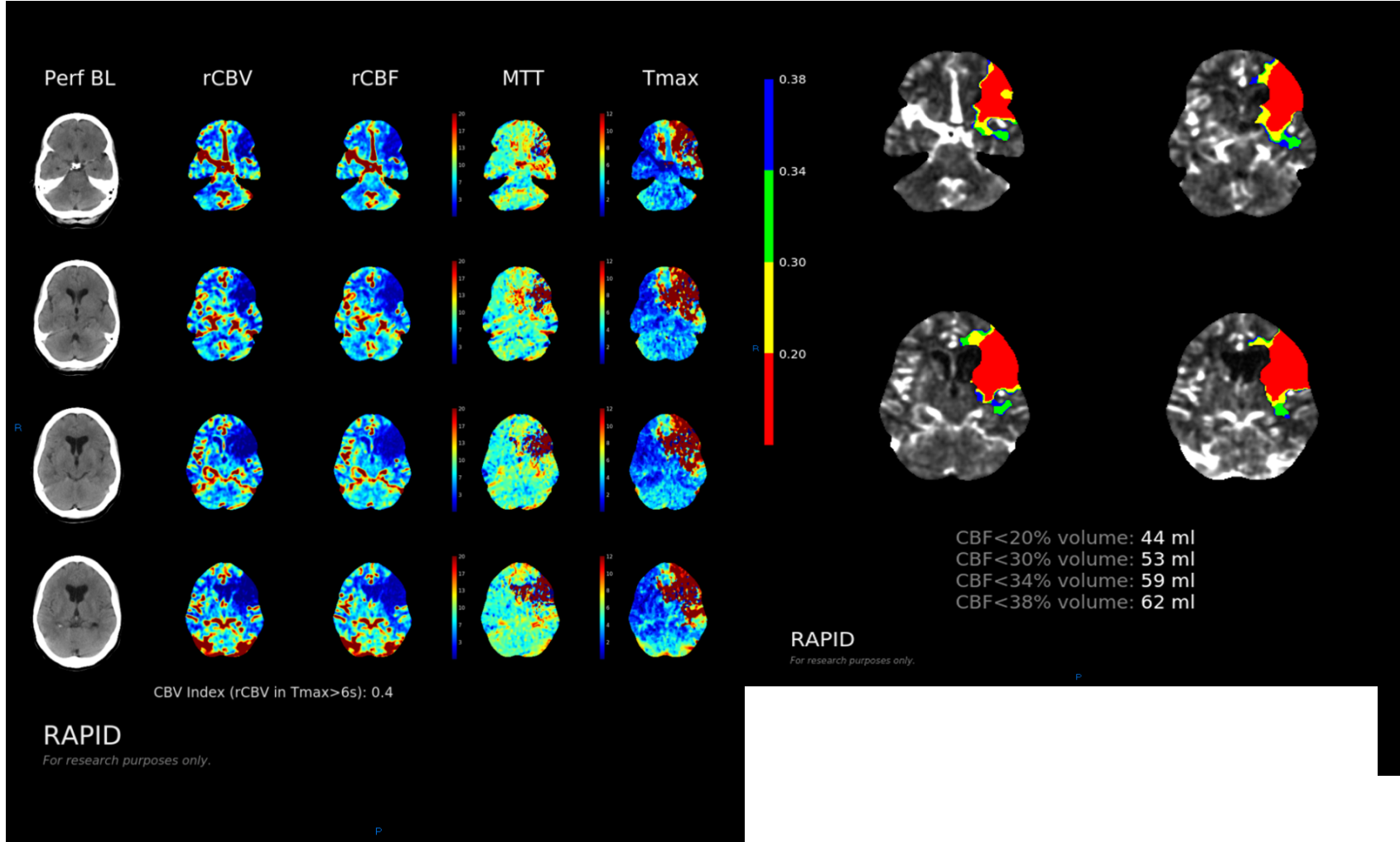


MISMATCH DIANA

- Core ideal (50-70 ml)
- +penumbra
- Mismatch ratio > 1,2-1,8



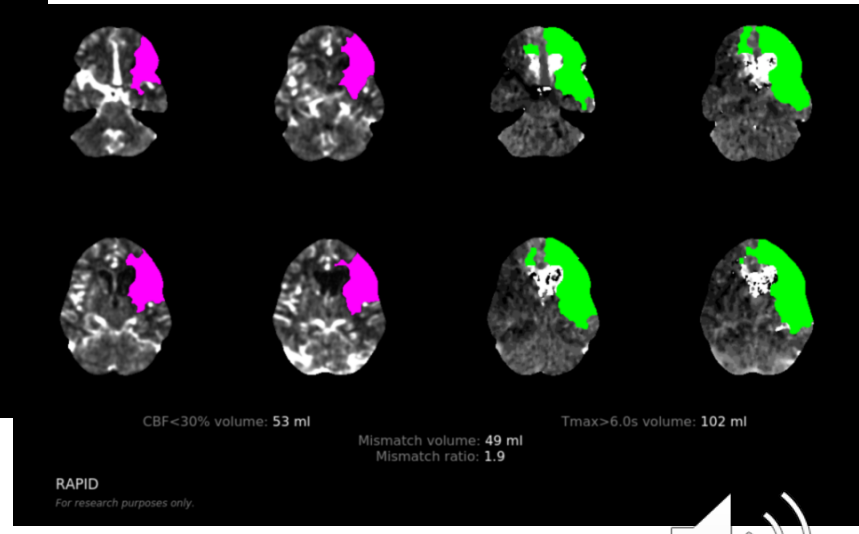
TCP/RMP ➔ PENUMBRA ➔ Técnicas de Detección Automática



CBF<20% volume: 44 ml
CBF<30% volume: 53 ml
CBF<34% volume: 59 ml
CBF<38% volume: 62 ml

Core: rCBF < 0,30-0,34
rCBV < 0,32-0,34

Penumbra: Tmax >6 sg



ANGIOTC/ANGIORM ➤ OCLUSIÓN VASCULAR



- Condicionante necesario para predecir eficacia del tratamiento trombolítico y selección de candidatos para trombectomía.

For patients who otherwise meet criteria for mechanical thrombectomy, noninvasive vessel imaging of the intracranial arteries is recommended during the initial imaging evaluation.

For patients with suspected LVO who have not had noninvasive vessel imaging as part of their initial imaging assessment for stroke, noninvasive vessel imaging should then be obtained as quickly as possible (eg, during alteplase infusion if feasible).



- Lugar de la oclusión

In patients with suspected intracranial LVO and no history of renal impairment, who otherwise meet criteria for mechanical thrombectomy, it is reasonable to proceed with CTA if indicated before obtaining a serum creatinine concentration.



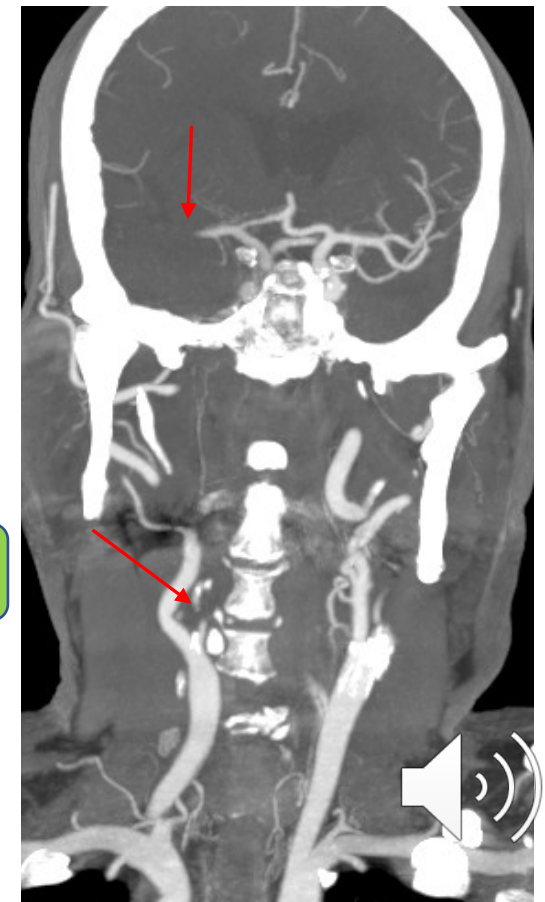
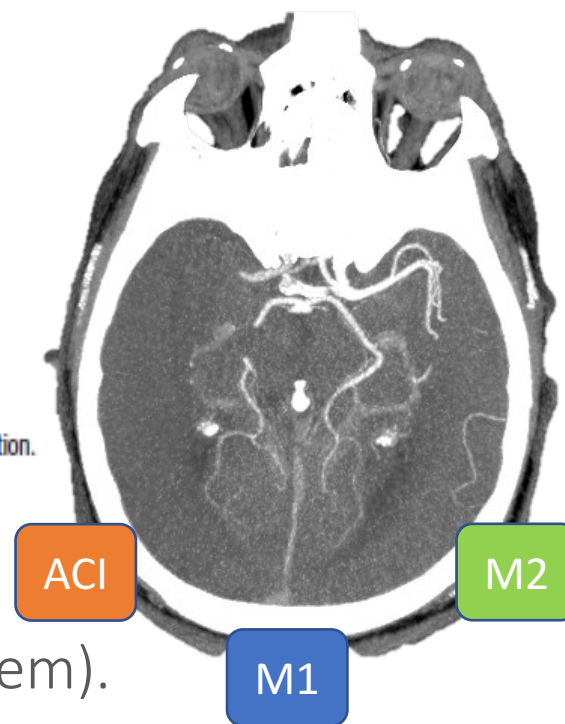
New recommendation.

- Mapa vascular pretratamiento (oclusiones tándem).

In patients who are potential candidates for mechanical thrombectomy, imaging of the extracranial carotid and vertebral arteries, in addition to the intracranial circulation, may be reasonable to provide useful information on patient eligibility and endovascular procedural planning.



New recommendation.



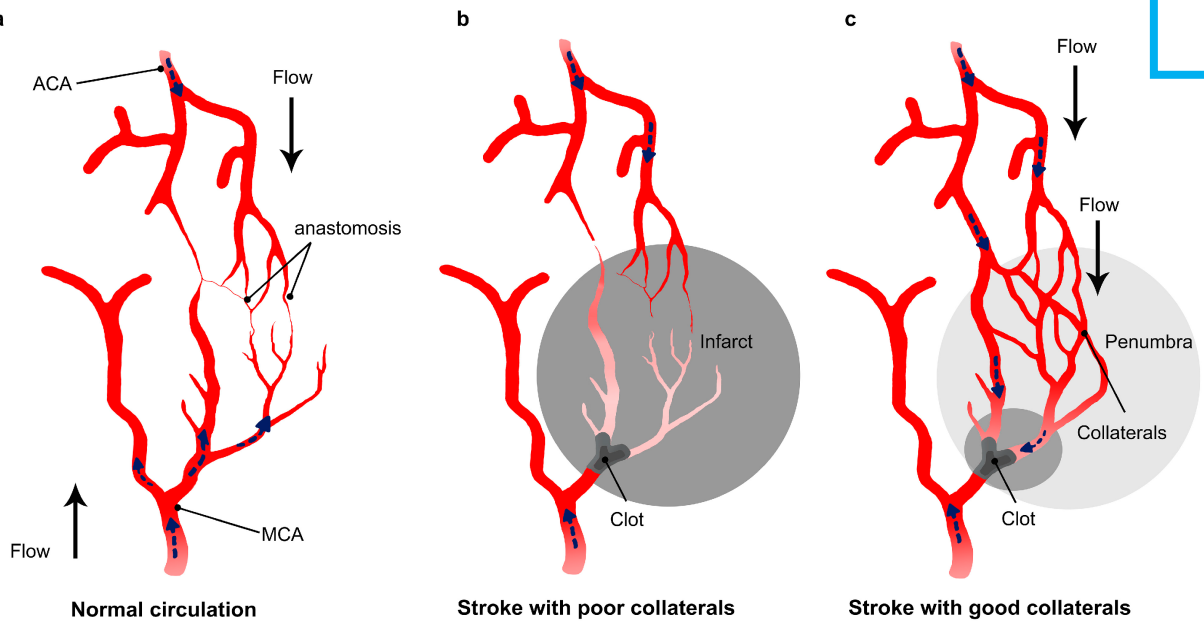
ANGIOTC/ANGIORM > COLATERALES



Leptomeningeas

Willisianas

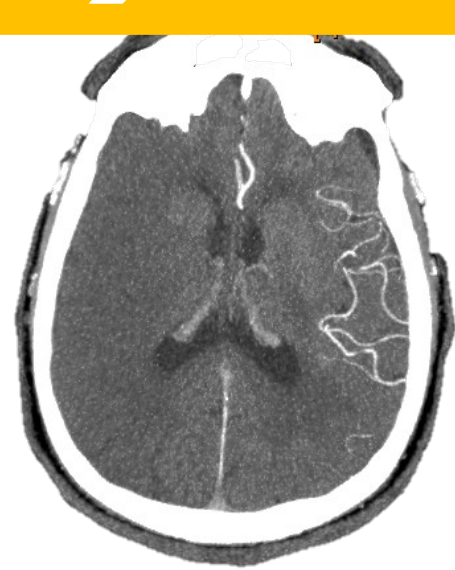
Extracraneales



ANGIOTC/ANGIORM ➤ **COLATERALES**



Tan modificado
Miteff **Lee (RM)**
ASPECTSc
Tan **Maas**



CS 0: 0%



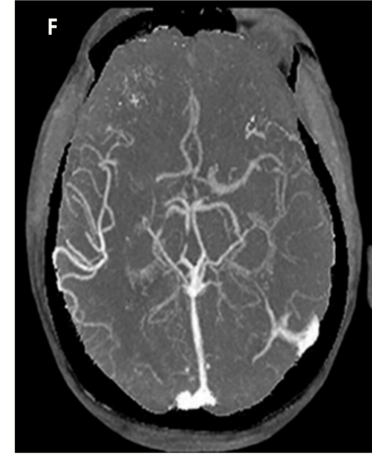
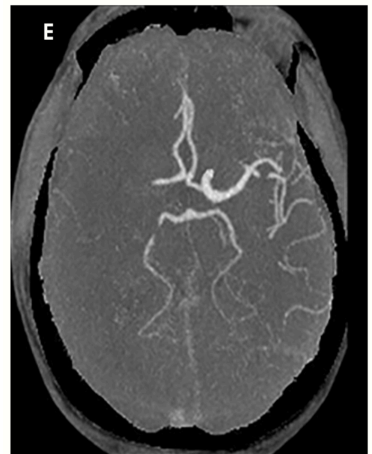
CS 1: 0-50%



CS 2: 50-100%



CS 3: ≥ 100%



ANGIOTC/ANGIORM ➤ COLATERALES



- Escasa colateralidad: core mayor, peor resultado funcional, mayor riesgo de complicaciones (hemorragia) y menor grado de repermeabilización en TM (Bang, Stroke 2011; Maas, Stroke 2009).
- ESCAPE ($\geq 50\%$).
- No relación directa con la extensión del tejido en penumbra (Nannoni, 2019)

<i>Radiological variables</i>	Core volume	Penumbra volume	Mismatch ratio
ASPECTS	1.08 (1.03–1.12)	–	–
Hyperdense	0.70	–	1.28
MCA sign	(0.55–0.89)		(1.04–1.59)
Distal intracranial occlusion	–	1.47 (1.11–1.94)	1.39 (1.06–1.82)
Clot burden score	1.10 (1.05–1.15)	1.08 (1.04–1.12)	–
Better collaterals	1.95 (1.44–2.63)	–	0.52 (0.39–0.70)

Distal intracranial occlusion indicates distal M1 or M2 occlusion

- Progresadores rápidos y lentos

It may be reasonable to incorporate collateral flow status into clinical decision-making in some candidates to determine eligibility for mechanical thrombectomy.

IIb

C-LD



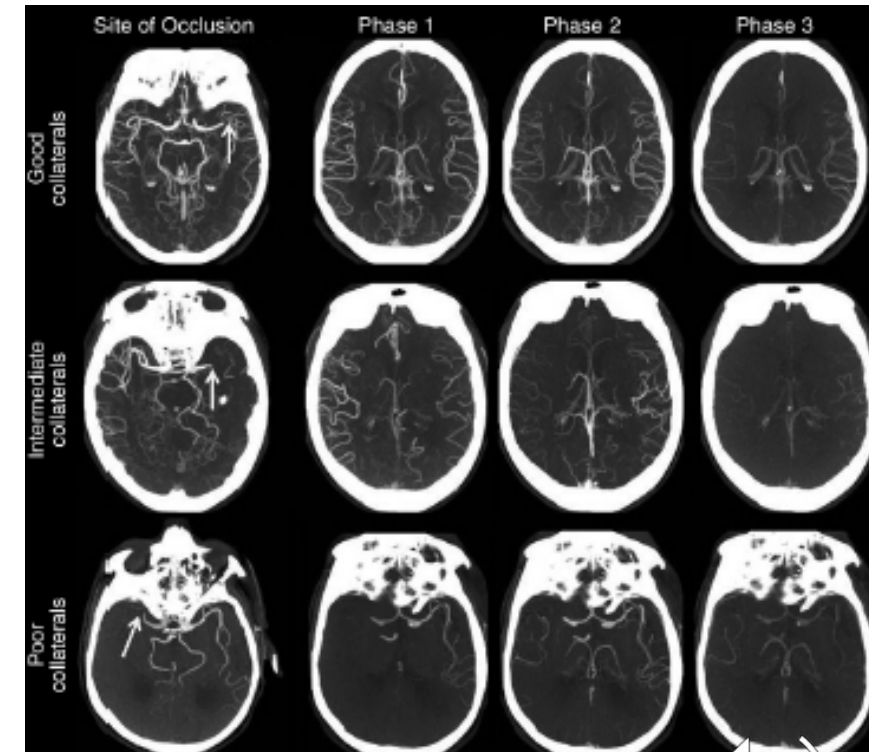
ANGIOTC ➤ COLATERALES ➤ ANGIOTC DINAMICO 4D



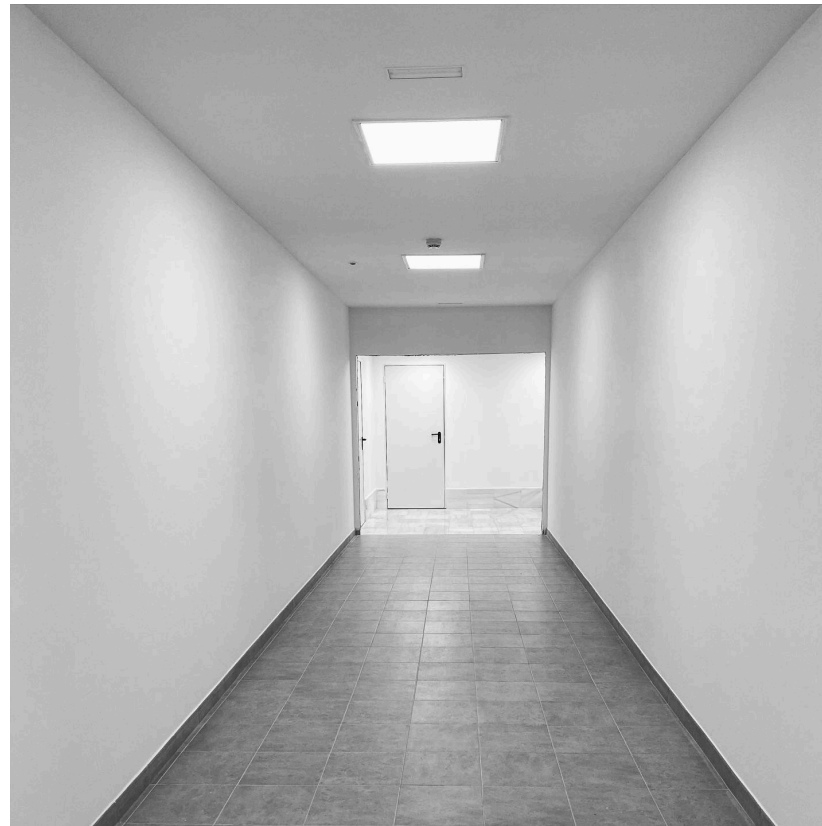
- ESCAPE. 3 fases
- Resolución temporal.
- Evita la sobreestimación del core isquémico y la infraestimación de colaterales.
- PROVE-IT en proceso (comparación AngioTC multifase vs CTP).



- Score colateralidad pial (6 grados). Tricotomizado
- Excelente concordancia interobservador
- Superior capacidad para predecir resultado funcional (TCbasal, AngioTC fase única, TCP)



Todo perfecto, pero a mí explicame paso por paso
qué tengo que hacer...

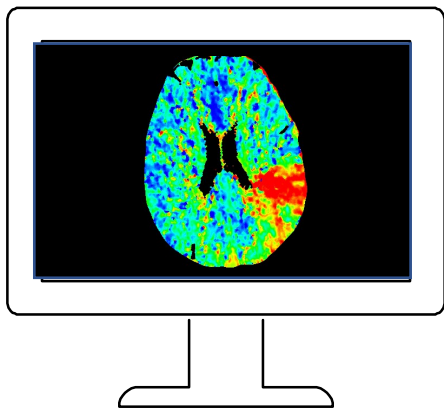


**CÓDIGO
ICTUS!**



TC Basal

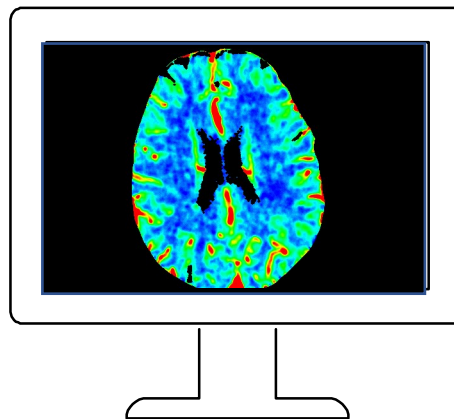
- ✓ Hemorragia, mimics
 - ✓ Arteria hiperdensa
- 15 – 30 sgs



TCP

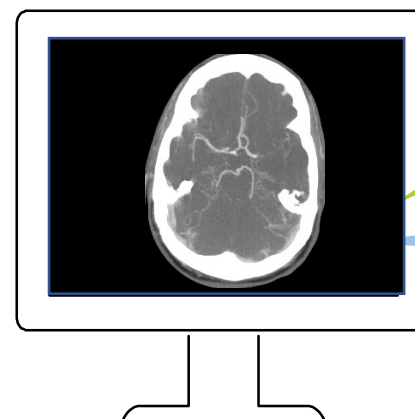
- ✓ TTM, Tmax
- 10 sgs

1er pase: 2-3 min



TCP

- ✓ VSC
- 10 sgs



AngioTC

- ✓ Oclusión vascular
 - ✓ colaterales
- 30-60 sgs

Normal

Patología no tromboembólica

Ictus agudo no candidato a tto

Ictus agudo candidato a tto

- ✓ Longitud y tipo de embolo
 - ✓ Acceso vascular
 - ✓ Otros hallazgos
- 2º pase**



Controversias

- Revisión crítica del core isquémico: estimación probabilística del tejido con alta posibilidad de terminar infartado sin reperusión precoz, pero no tejido infartado real (variabilidad en vulnerabilidad neuronal, reversibilidad de la isquemia, core fantasma, ausencia gold-standard, variabilidad entre las técnicas de detección automática). Mejor **SIT-uv: Tejido gravemente isquémico de viabilidad incierta** (Goyal M, et al. Stroke, 2020).
- Discrepacias entre volumen de infarto y resultado clínico. TESLA, TENSION, SELECT-2, IN-EXTREMIS, RESCUE-Japan LIMIT.
- Pacientes “excluidos” de los ensayos:
 - ASPECTS <6
 - NIHSS < 6
 - oclusión de vaso distal
 - ictus de circulación posterior
 - ictus > 24h.



Stroke Imaging Selection Modality and Endovascular Therapy Outcomes in the Early and Extended Time Windows

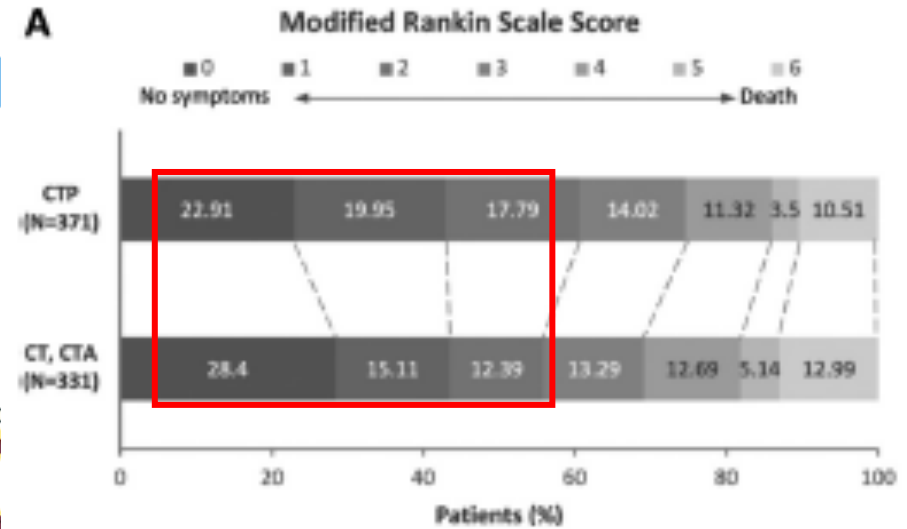
Raul G. Nogueira MD; Diogo C. Haussen, MD; David Liebeskind MD; Tudor G. Jovin, MD; Rishi Gupta, MD; Ashutov Jadhav, MD, PhD; Ron F. Budzik, MD; Blaise Baxter, MD; Antonin Krajina, MD; Alain Bonafe, MD; Ali Malek, MD; Ana Paula Narata, MD; Ryan Shields, MSc; Yanchang Zhang, PhD; Patricia Morgan, BSN, RN; Bruno Bartolini, MD; Joey English, MD, PhD; Michael R. Frankel, MD; Erol Veznedaroglu, MD; for the **Trevo Registry and DAWN Trial Investigators**

BACKGROUND AND PURPOSE: Advanced imaging has been increasingly used for patient selection in endovascular stroke therapy. The impact of imaging selection modality on endovascular stroke therapy clinical outcomes in extended time window remain to be defined. We aimed to study this relationship and compare it to that noted in early-treated patients.

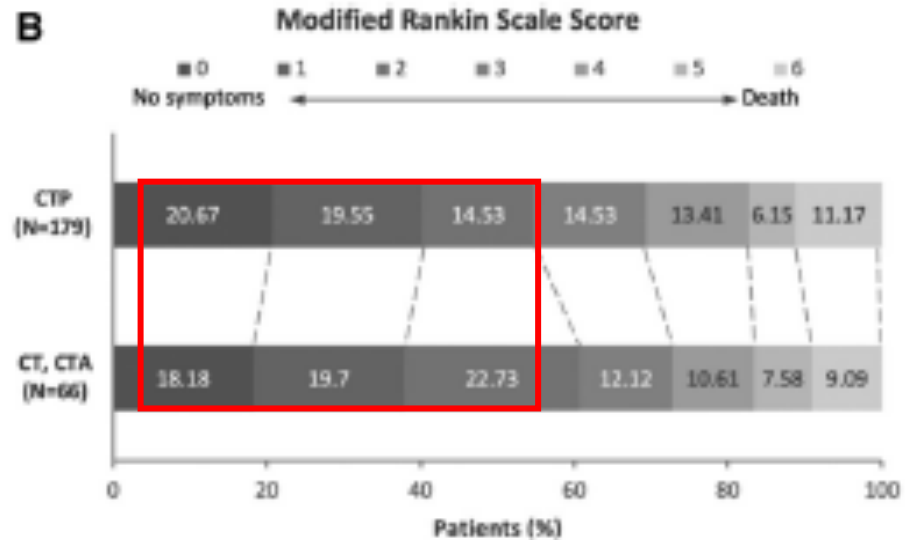
METHODS: Patients from a prospective multicentric registry (n=2008) with occlusions involving the intracranial internal carotid or the M1- or M2-segments of the middle cerebral arteries, pre-morbid modified Rankin Scale score 0 to 2 and first treatment 0 to 24 hours were categorized according to treatment times within the early (0–6 hour) or extended (6–24 hour) window as well as imaging modality with noncontrast computed tomography (NCCT)±CT angiography (CTA) or NCCT and CT perfusion (CTP). The association between imaging modality and 90-day modified Rankin Scale, analyzed in a dichotomized (functional independence, modified Rankin Scale score 0–2) manner was evaluated and compared within and across the extended and early windows.

RESULTS: In the early window, 332 patients were selected with NCCT±CTA alone while 373 also underwent CTP. Adjusting for identifiable confounders, there were no significant differences in terms of 90-day functional disability (shift: adjusted odd ratio [aOR], 0.936 [95% CI, 0.709–1.238], P=0.644) or independence (aOR, 1.178 [95% CI, 0.81–1.666], P=0.355) across the CTP and NCCT±CTA groups. In the extended window, 67 patients were selected with NCCT±CTA alone while 180 also underwent CTP. No significant differences in 90-day functional disability (aOR, 0.95 [95% CI, 0.81–1.12], P=0.949) or independence (aOR, 0.640 [95% CI, 0.318–1.289], P=0.212) were seen across CTP and NCCT±CTA groups. There was no interaction between the treatment time window (0–6 versus 6–24 hour) and CT selection modality (CTP versus NCCT±CTA) in terms of functional disability at 90 days (P=0.45).

CONCLUSIONS: CTP acquisition was not associated with better outcomes in patients treated in the early or extended time windows. While confirmatory data is needed, our data suggests that extended window endovascular stroke therapy remain beneficial even in the absence of advanced imaging.



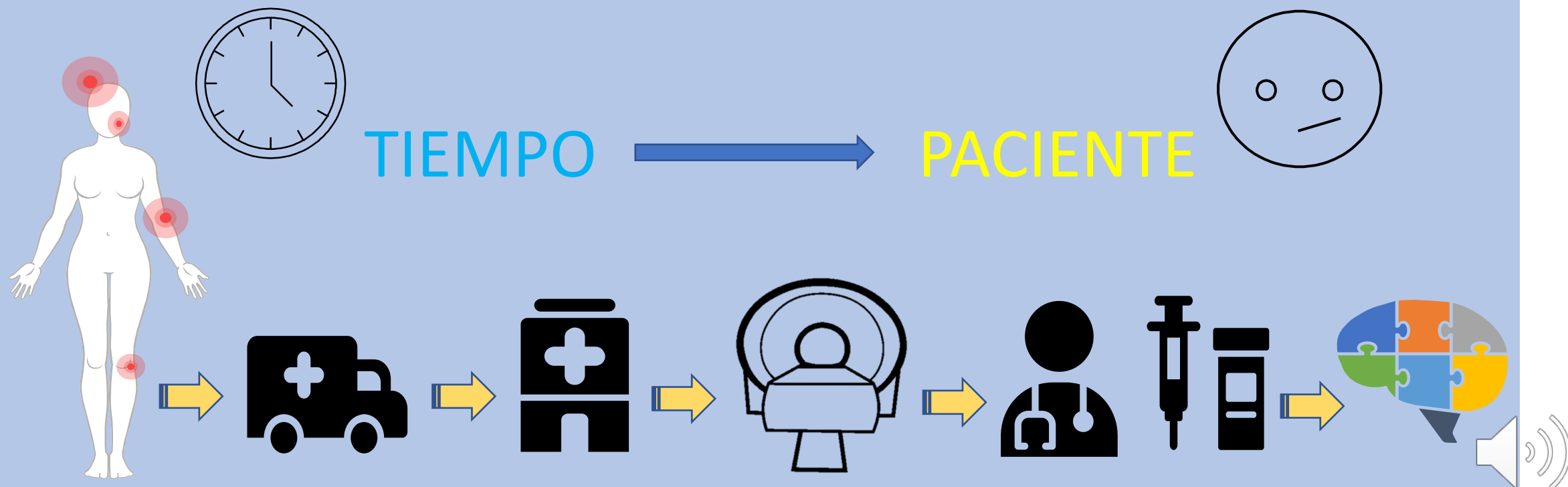
0-6 h



6-24 h



"Soy un cerebro, Watson. El resto de mí es un mero apéndice"



Conclusiones

- TC multimodalidad como pilar clave en el diagnóstico del cuadro ictal agudo, la selección de pacientes candidatos a tratamiento y la predicción del resultado funcional.
- En ictus 0-6h están indicadas TC basal y Angio-TC de TSA y cráneo.
- En ictus 6-24h o de tiempo de evolución desconocido se añade la necesidad de TC perfusión para la selección de candidatos a tratamiento
- La escala de ASPECTS en TC basal y la escala de colaterales en Angio-TC son potentes predictores de resultado funcional postrevascularización.
- Las herramientas de apoyo del código ictus basadas en IA ayudan a mejorar y simplificar la evaluación de los estudios.





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