Thrombectomie : imagerie pré-opératoire

B.Claise, S.Mirafzal, R.Aouini,
E.Chabert, A.Zerroug, R.Moreno, E.Lteif, M.Rawas
Neuroradiologie CHU Gabriel Montpied
Clermont-Ferrand

Jean Gabrillargues

Diffusion

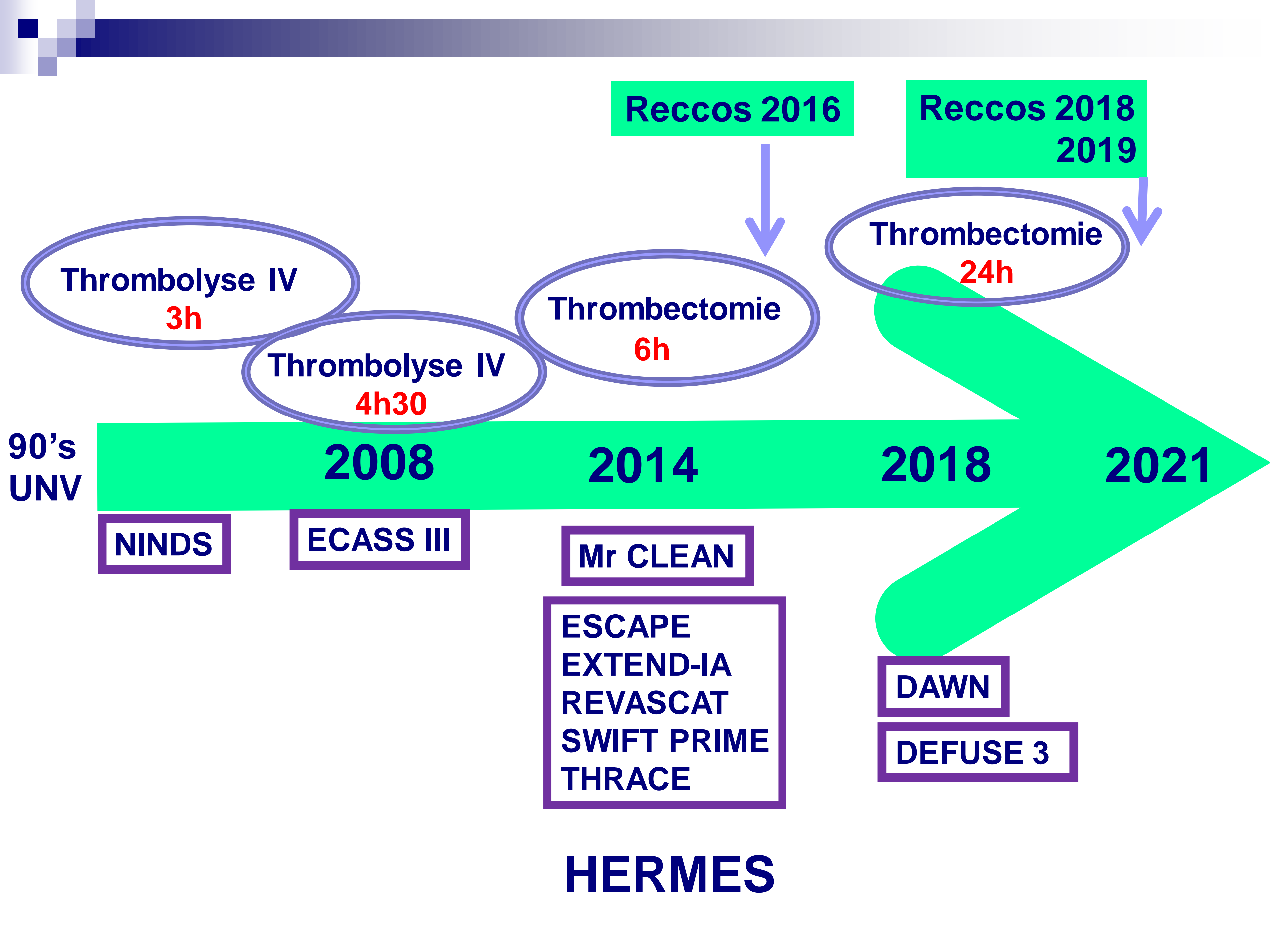
Perfusion

TDM

IRM

ASPECTS

TSA


Reccos 2016
Reccos 2018
2019
Thrombolyse IV
3h
Thrombolyse IV
4h30
Thrombectomie
6h
Thrombectomie
24h
90's
UNV
2008
2014
2018
2021
NINDS
ECASS III
Mr CLEAN
ESCAPE
EXTEND-IA
REVASCAT
SWIFT PRIME
THRACE
DAWN
DEFUSE 3
HERMES

2016

Consensus

Mechanical thrombectomy in acute ischemic stroke: Consensus statement by ESO-Karolinska Stroke Update 2014/2015, supported by ESO, ESMINT, ESNR and EAN

International Journal of Stroke
2016, Vol. 11(1) 134–147
© 2016 World Stroke Organization
Reprints and permissions: sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/1747493015609778
wso.sagepub.com
SAGE

La technique de thrombectomie mécanique présente un intérêt dans la prise en charge des patients ayant un AVC ischémique aigu, en rapport avec une occlusion d'une artère intracrânienne de gros calibre de la circulation antérieure, visible à l'imagerie dans un délai de 6 heures après le début des symptômes,

2018

2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Guideline

EUROPEAN STROKE JOURNAL

Consensus statements and recommendations from the ESO-Karolinska Stroke Update Conference, Stockholm 11–13 November 2018

European Stroke Journal
2019, Vol. 4(4) 307–317
© European Stroke Organisation 2019
Article reuse guidelines: sagepub.com/journals-permissions
DOI: 10.1177/2396987319863606
journals.sagepub.com/home/eso
SAGE

2019

Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

> 6h

Rôle de l'imagerie

- Diagnostic +
  - Exclure l'hématome
  - Confirmer l'infarctus
  - Eliminer les diagnostics différentiels

- Caractérisation de l'infarctus
  - Site d'occlusion
  - Ancienneté
  - Etendue de la nécrose
  - Etendue de la pénombre
  - Circulation collatérale

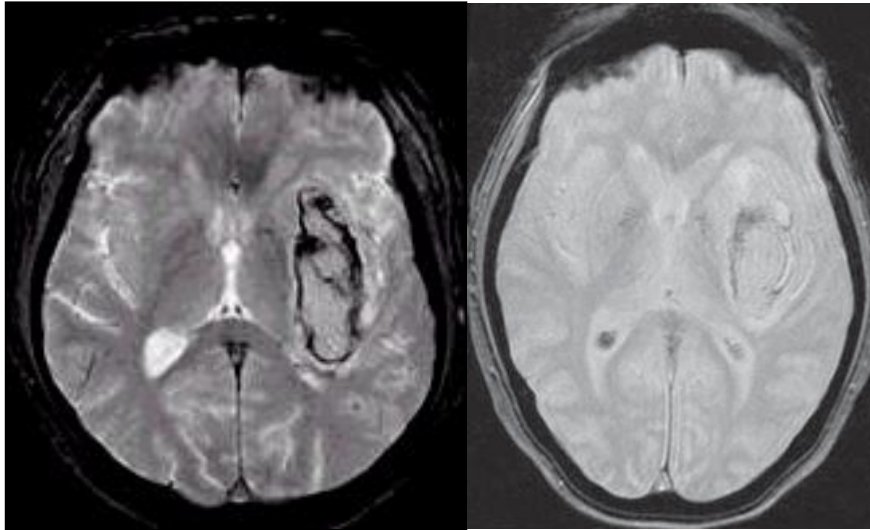
} TISSU A SAUVER

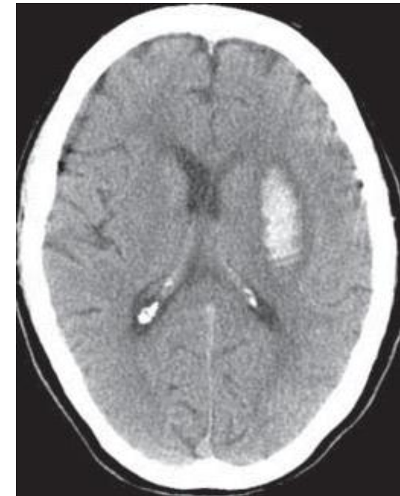
> 6h

Diagnostic + : exclure l'hématome

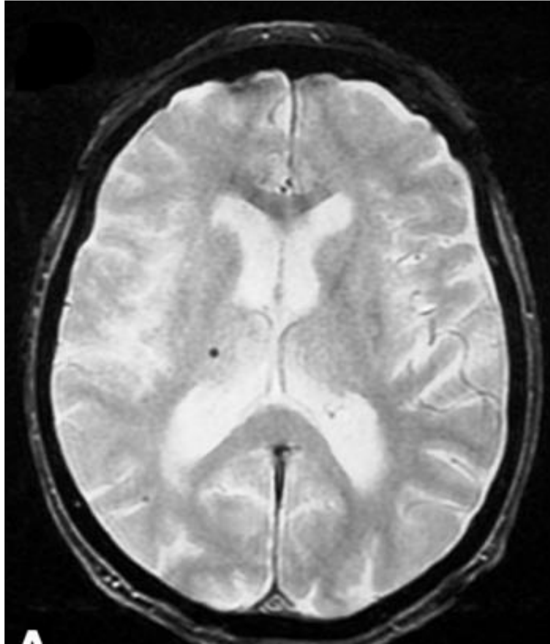
IRM : T2*

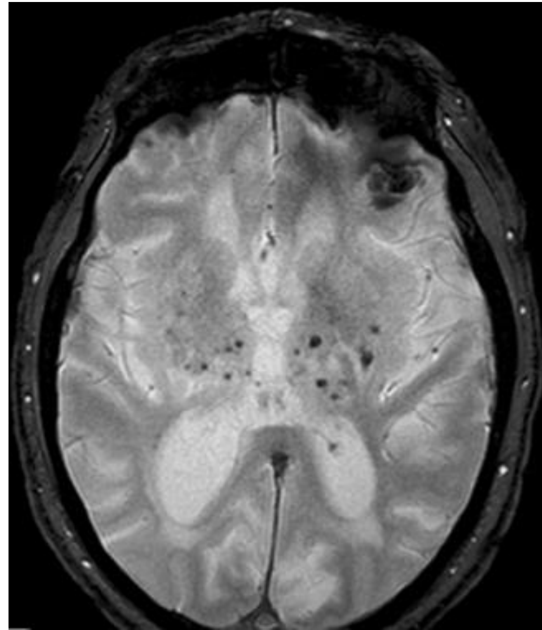
TDM : sans IV

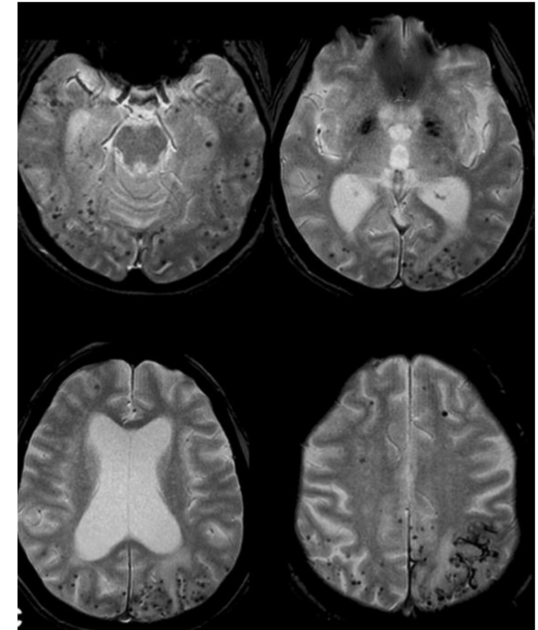




IRM T2* : microbleeds?







5. Routine use of magnetic resonance imaging (MRI) to exclude cerebral microbleeds (CMBs) before administration of IV alteplase is not recommended.	III: No Benefit	B-NR

2.2.2. IV Alteplase Eligibility	COR	LOE
1. Administration of IV alteplase in eligible patients without first obtaining MRI to exclude cerebral microbleeds (CMBs) is recommended.	I	B-NR

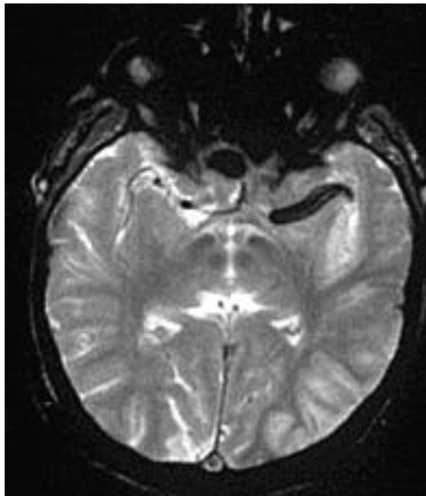
Powers et al 2018 et 2019 Guidelines for Management of Acute Ischemic Stroke

Diagnostic + : confirmer l'AVC

Visualisation du thrombus

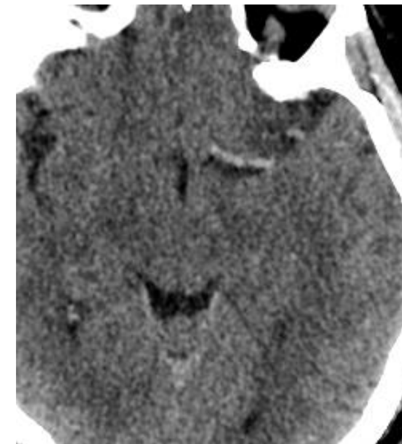
IRM : T2*

Susceptibility Vessel Sign



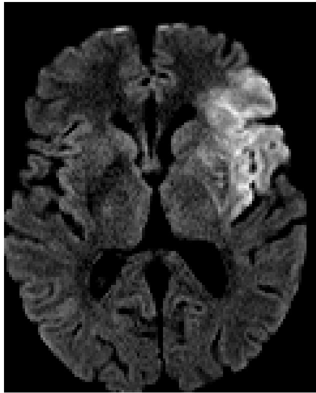
TDM : sans IV

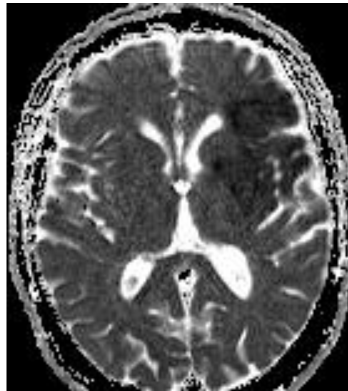
Artère hyperdense
(« trop belle artère »)



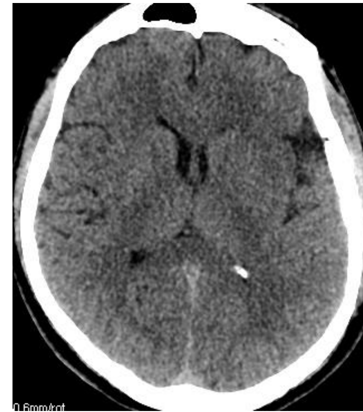
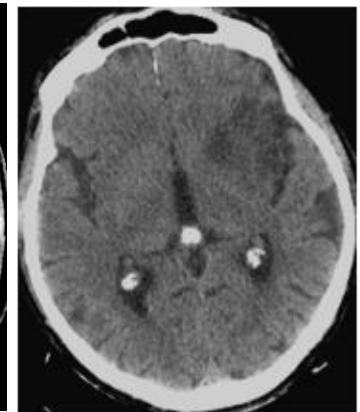
Diagnostic + : confirmer l'AVC

IRM : Diffusion

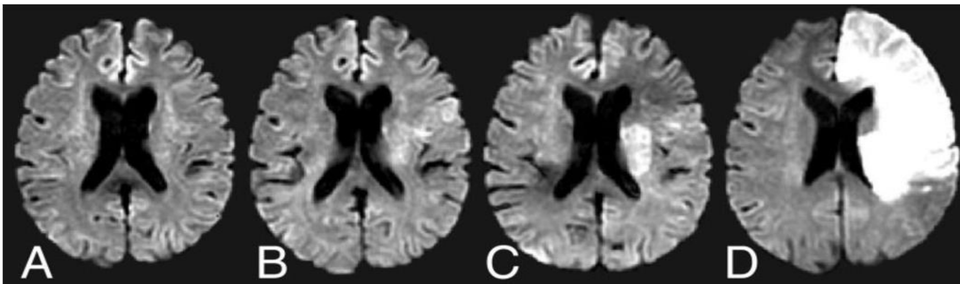

b1000


ADC

TDM : sans IV

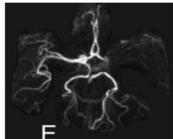
Précoce+++



Before deficit + 11 min + 3h + 24h

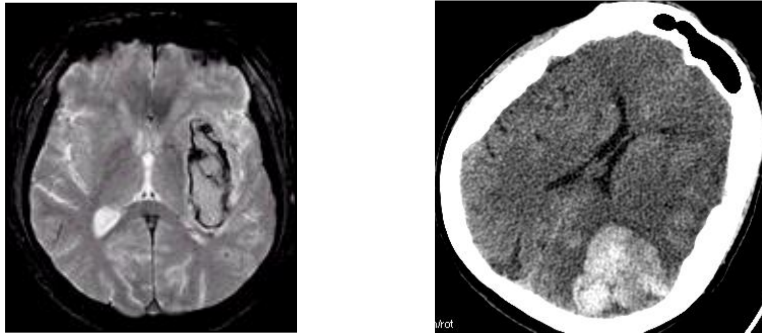
Ischemic Injury Detected by Diffusion Imaging 11 Minutes after Stroke

Niels Hjort, MD,[1,2] Søren Christensen, MSc,[1] Christine Sølling, MD,[1] Mahmoud Ashkanian, MD,[1] Ona Wu, PhD,[1] Lisbeth Røhl, MD, PhD,[1] Carsten Gyldensted, MD, PhD,[1] Grethe Andersen, MD, PhD,[2] and Leif Østergaard, MD, PhD[1]

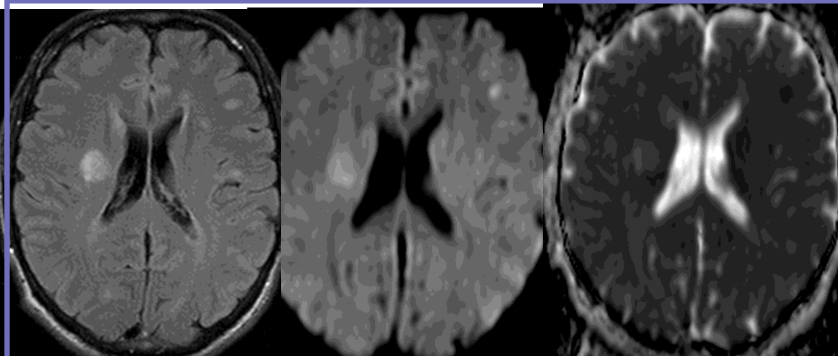


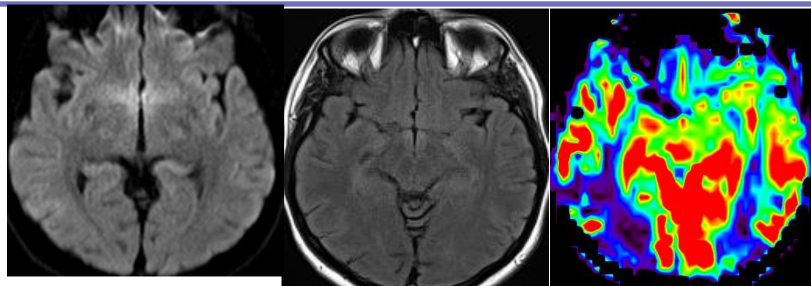
- Normal
- Perte de différenciation gris/blanc :
  - Noyaux gris centraux
  - Ruban insulaire
- Effacement des sillons
- Hypodensité franche

Diagnostic différentiel


Hématome+++

TDM / IRM


SEP

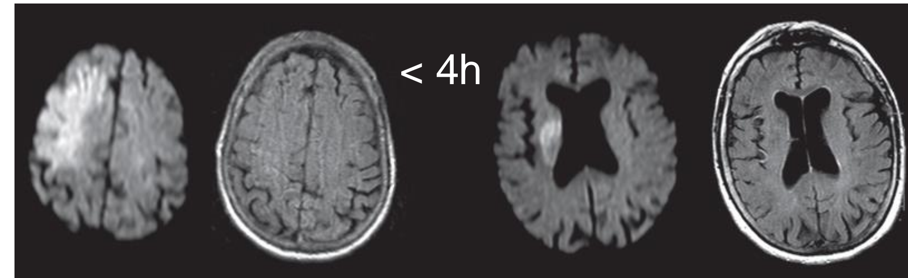

Aura migraineuse

Poussée de SEP
Aura migraineuse
EPPR
Thrombophlébite
MELAS,,,

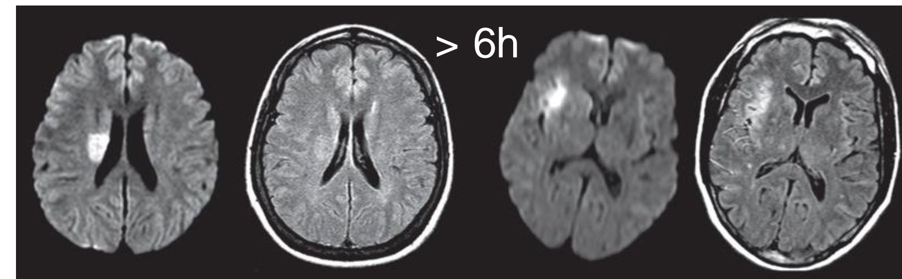
→ IRM++

Caractérisation de l’infarctus : ancienneté

IRM : FLAIR



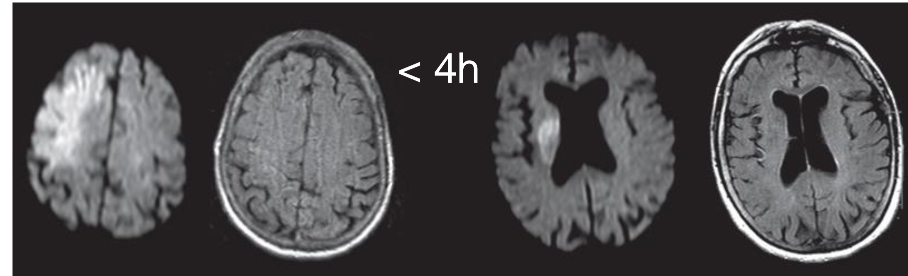
- Signes parenchymateux:
  - Apparaissent entre 4 et 6h

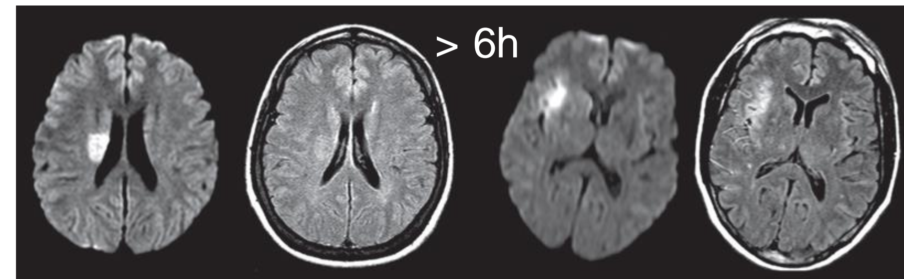


  - Comparaison FLAIR/diff permet d’évaluer l’ancienneté (AVC du réveil ++, heure de début des symptômes inconnue)

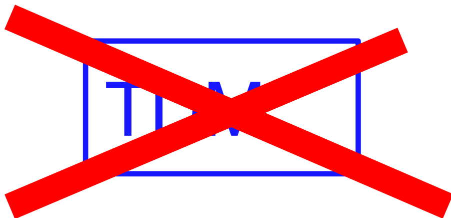
Caractérisation de l'infarctus : ancienneté

IRM : FLAIR





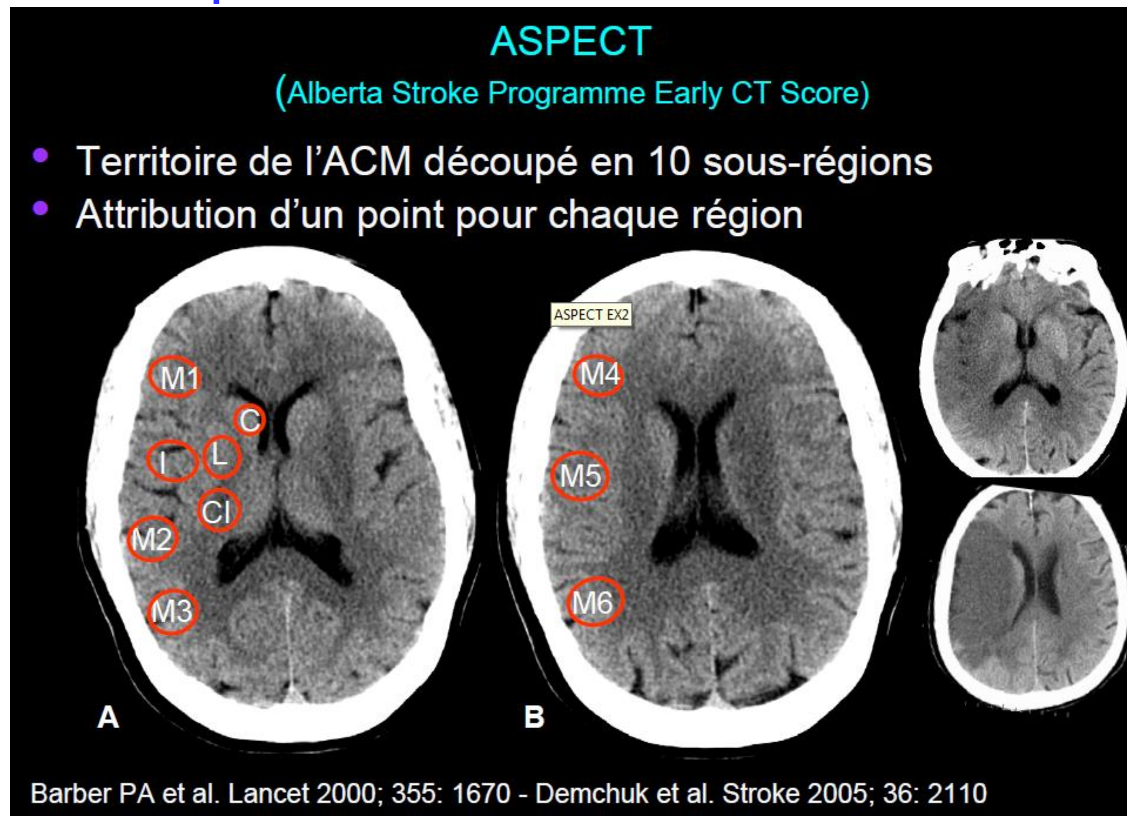
- Signes parenchymateux:
  - Apparaissent entre 4 et 6h
  - Comparaison FLAIR/diff permet d'évaluer l'ancienneté (AVC du réveil ++, heure de début des symptômes inconnue)



AVC du réveil : IRM

Caractérisation de l'infarctus : évaluation de l'étendue de la nécrose

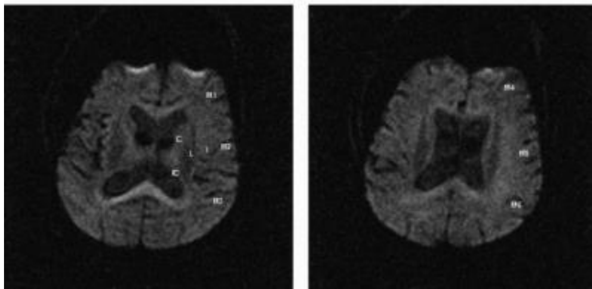
- Facteur pronostic
- Profil malin : transformation hémorragique, mauvaise évolution clinique



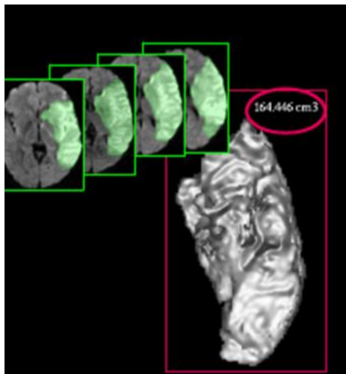
Caractérisation de l'infarctus : core

IRM : Diffusion

ASPECT DWI ≤ 5

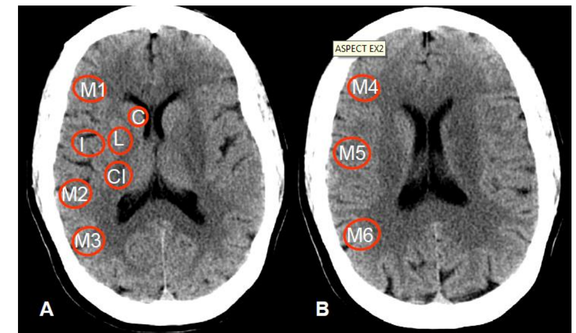


Volume > 100ml (DWI) ,70 ml (PWI (Tmax >6))



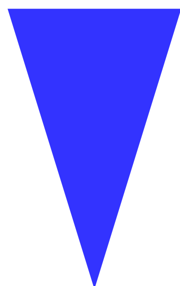
TDM : sans IV

Score ASPECT ≤ 7

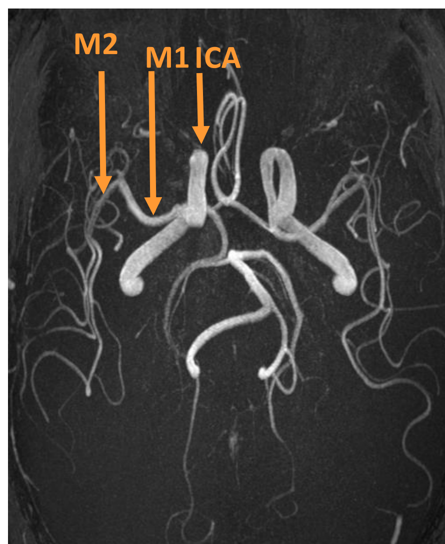


Caractérisation de l'infarctus : site d'occlusion

Recanalization rates
1 hr after IV rt-PA



>M2: 75%
M2: 40%
M1: 28%
ICA: 8%



Del Zoppo et al. Ann Neurol. 1992; 32: 78-86.
Wolpert et al. AJNR Am J Neuroradiol. 1993; 14: 3-13.

la technique de thrombectomie mécanique présente un intérêt dans la prise en charge des patients ayant un AVC ischémique aigu, en rapport avec une occlusion d'une artère intracrânienne de gros calibre de la circulation antérieure, visible à l'imagerie dans un délai de 6 heures après le début des symptômes,

ACI, M1, (M2)

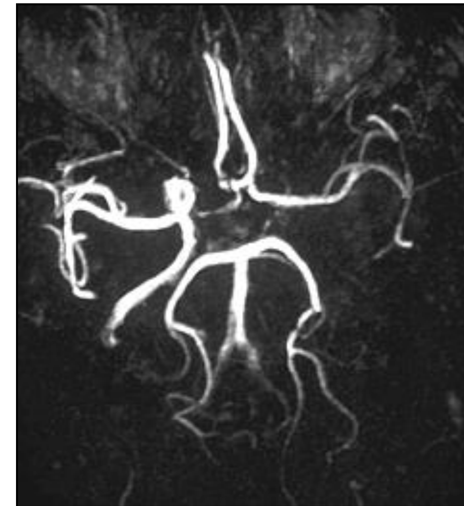
HAS
HAUTE AUTORITÉ DE SANTÉ
RAPPORT D'EVALUATION TECHNOLOGIQUE
Thrombectomie des artères intracrâniennes par voie endovasculaire
Novembre 2016

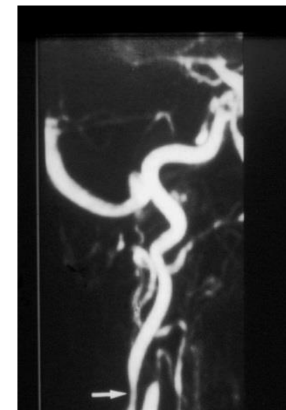
Caractérisation de l'infarctus : site d'occlusion

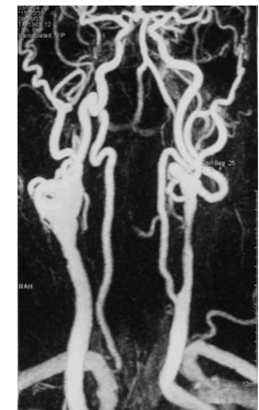
ARM

- TOF :
  - Imagerie de flux
    - Défaut de visualisation d'une artère =
      - Occlusion
      - Ralentissement important
  - Visualisation vx intra-crâniens
  - Vx cervicaux non vus

- AngioIRM Gado
  - Imagerie non dépendante du flux
  - Visualisation vx intra-crâniens ET extra-crâniens
  - Séquence + rapide





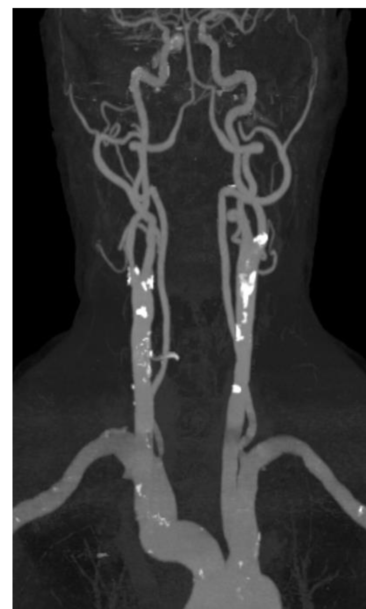


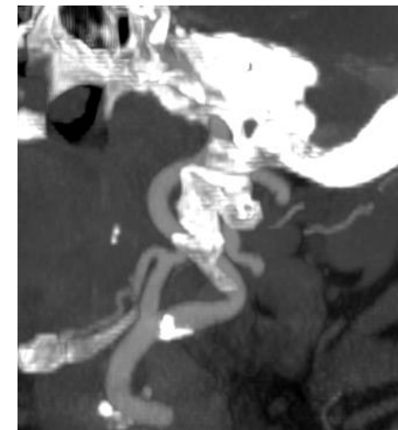
10. In patients who are potential candidates for mechanical thrombectomy, imaging of the extracranial carotid and vertebral arteries, in addition to the intracranial circulation, is reasonable to provide useful information on patient eligibility and endovascular procedural planning.	IIa	C-EO

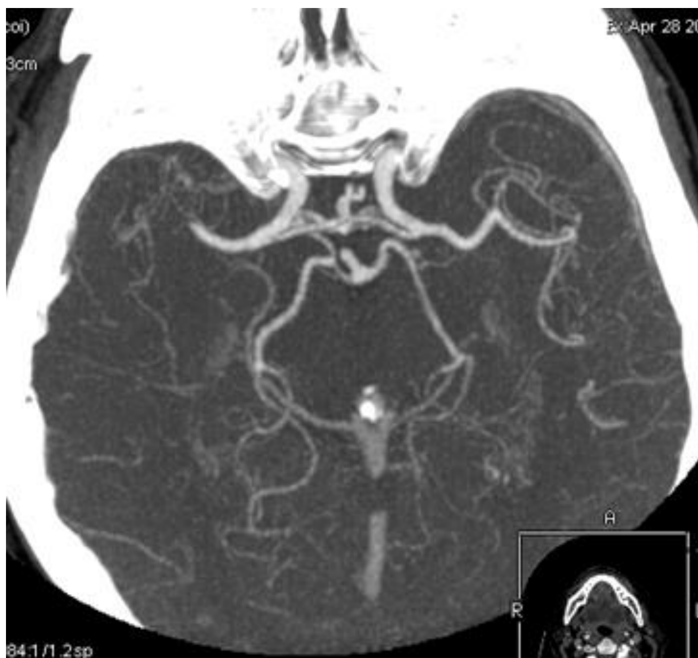
Caractérisation de l'infarctus : site d'occlusion

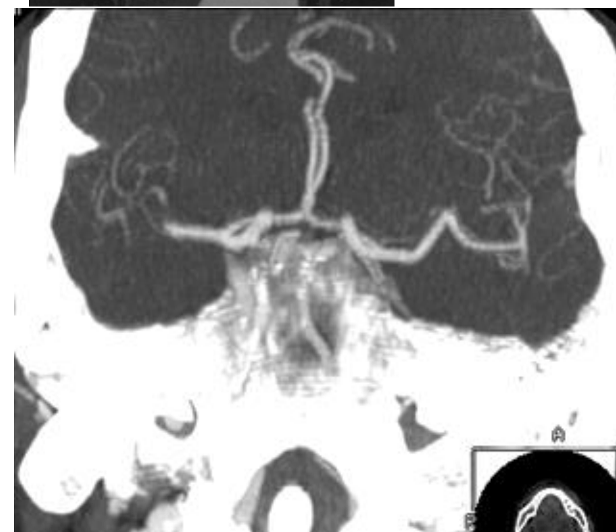
AngioTDM

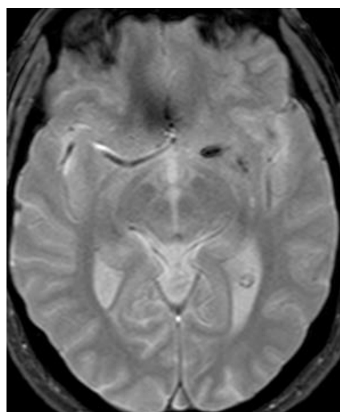
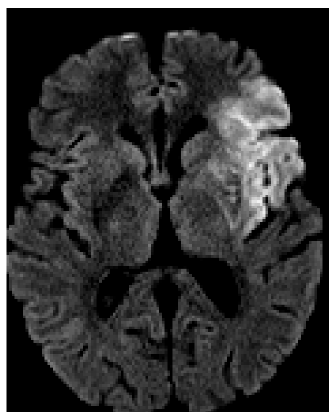
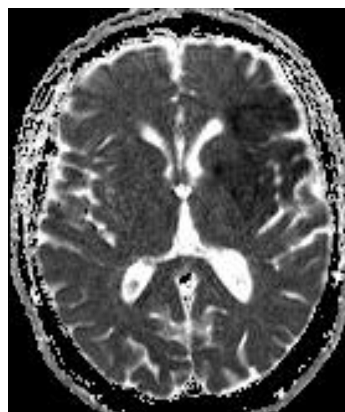
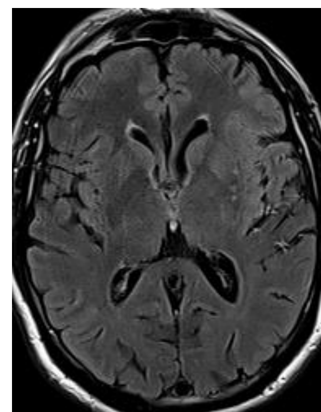
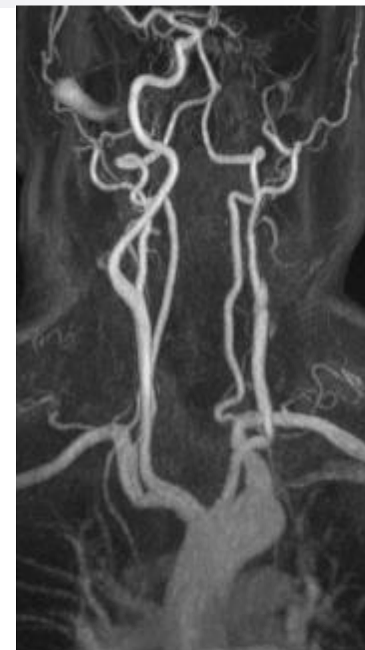
TSA+polygone
Site de l'occlusion
Etat de la vascularisation d'amont





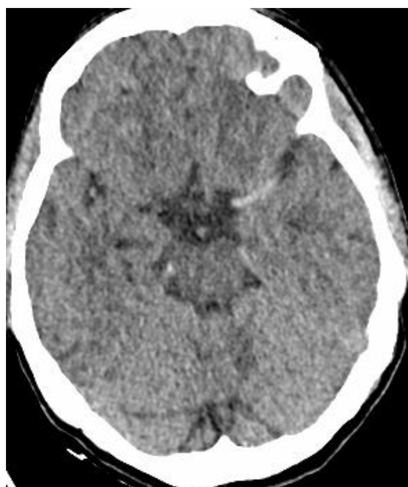
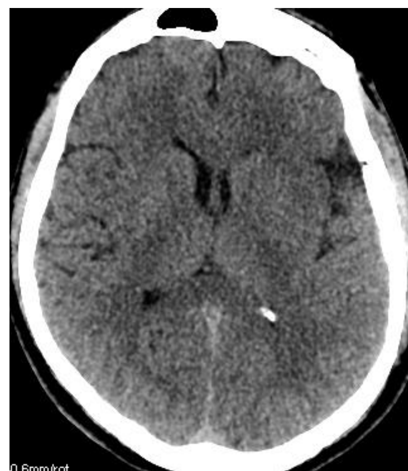
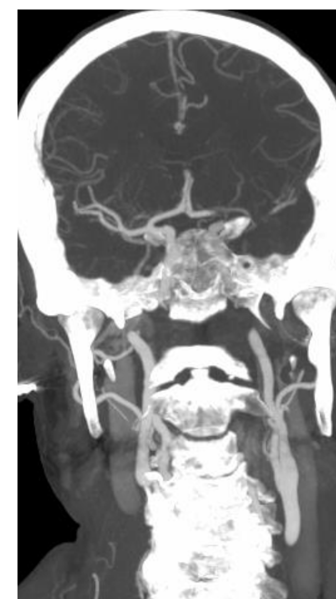




Patient vu à 3h du début des symptômes :
Hémiplégie droite totale et aphasie
NIHSS 17

Mismatch clinicoradiologique

Rôle de l'imagerie

- Diagnostic +
  - Exclure l'hématome
  - Confirmer l'infarctus
  - Eliminer les diagnostics différentiels
- Caractérisation de l'infarctus
  - Site d'occlusion
  - Ancienneté
  - Etendue de la nécrose
  - Etendue de la pénombre
  - Circulation collatérale

} **TISSU A SAUVER**

> 6h

Evaluer l’étendue de la pénombre

Perfusion

- Perfusion : intérêt discuté < 6h
- Nécessaire si
  - Délai > 6h
  - Clinique atypique
  - IRM Diffusion normale

Perfusion

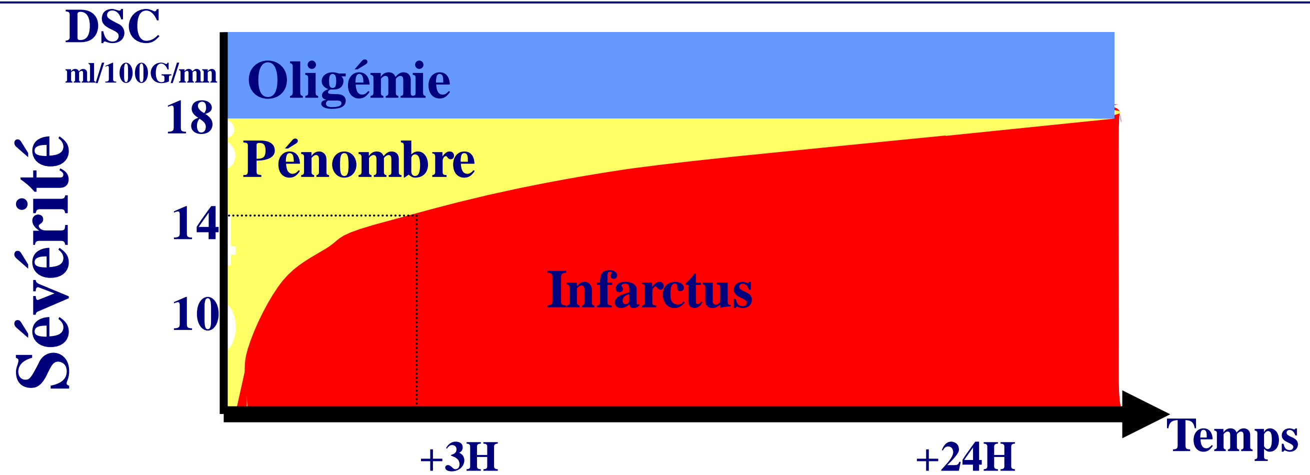
11. Additional imaging beyond CT and CTA or MRI and magnetic resonance angiography (MRA) such as perfusion studies for selecting patients for mechanical thrombectomy in <6 hours is not recommended.	III: No Benefit	B-R	New recommendation.

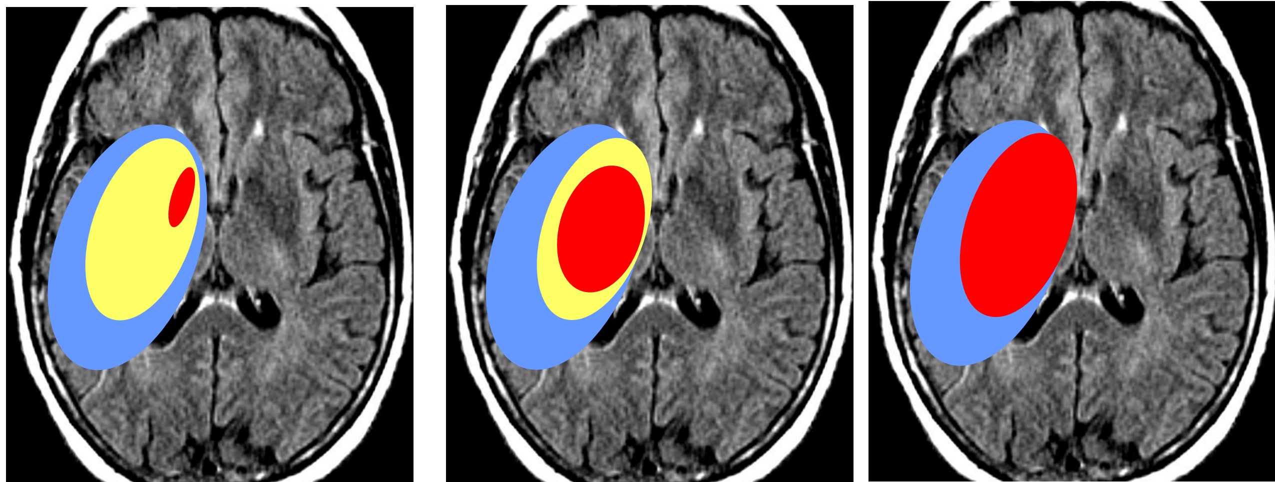
2.2. Brain Imaging (Continued)	COR	LOE	New, Revised, or Unchanged
12. In selected patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation, obtaining CTP, DW-MRI, or MRI perfusion is recommended to aid in patient selection for mechanical thrombectomy, but only when imaging and other eligibility criteria from RCTs showing benefit are being strictly applied in selecting patients for mechanical thrombectomy.	I	A	New recommendation.

Powers et al 2018 Guidelines for Management of Acute Ischemic Stroke

Perfusion

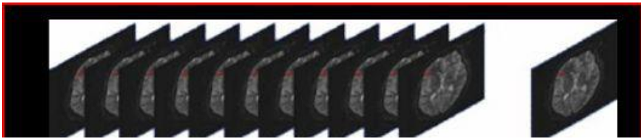
Evaluer l’étendue de la pénombre

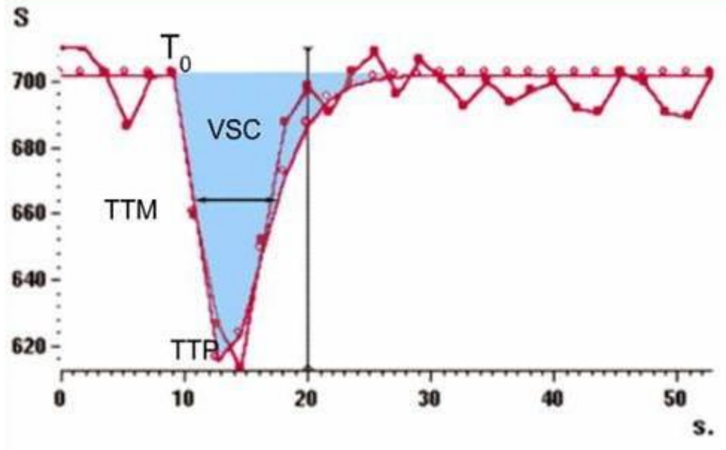




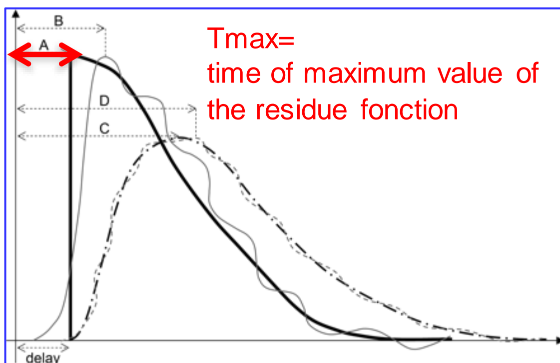
IRM Perfusion

Etude du 1er passage d'un chélate de Gadolinium



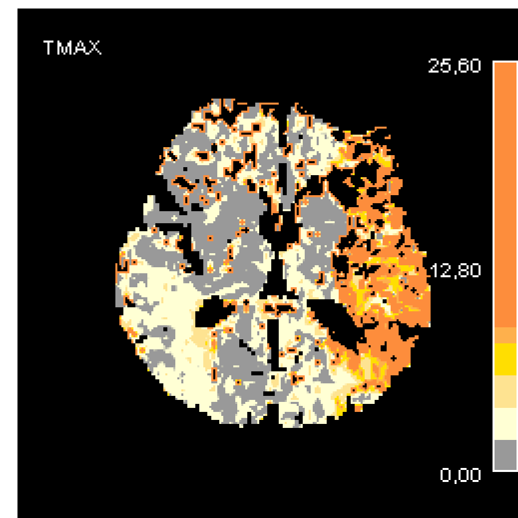


MTT = Mean Transit Time TTM = Temps de Transit Moyen (sec)	représente l'intervalle de temps moyen nécessaire à un bolus unitaire instantané de produit de contraste iodé pour traverser le réseau capillaire cérébral
TTP = Time to Peak (sec)	temps jusqu'au pic de rehaussement maximal de contraste
CBV = Cerebral Blood Volume VSC = Volume Sanguin Cérébral (ml / 100 grammes)	désigne la fraction de parenchyme occupée par les vaisseaux sanguins
CBF = Cerebral Blood Flow DSC = Débit Sanguin Cérébral (ml / 100 grammes / minute)	désigne le débit sanguin à travers les vaisseaux cérébraux

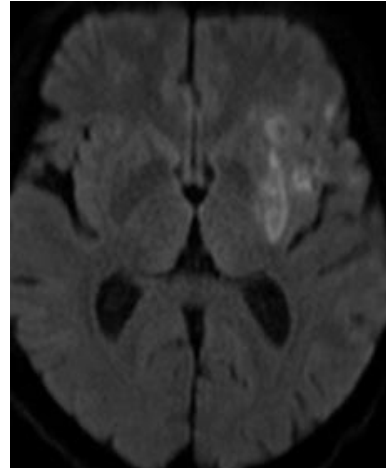
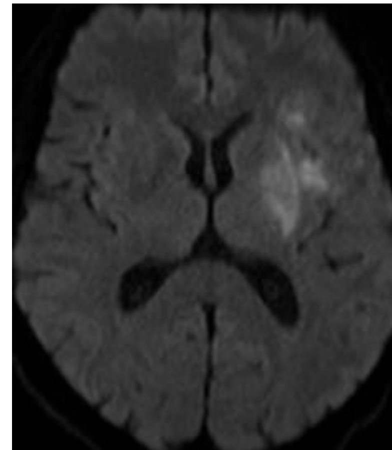
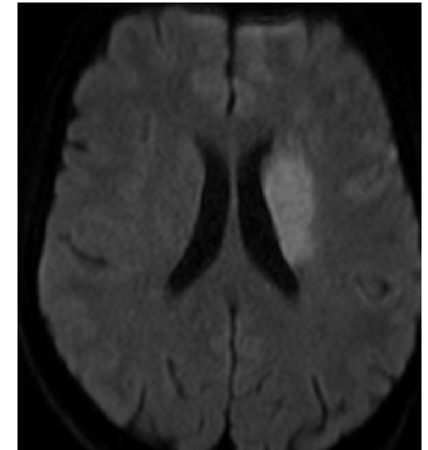


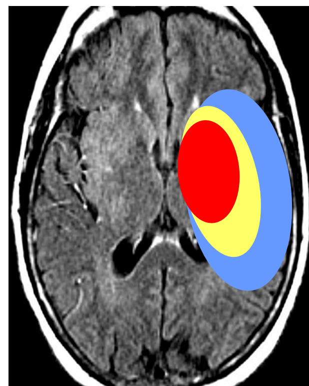
Tmax=
time of maximum value of the residue fonction

Tmax >6 s

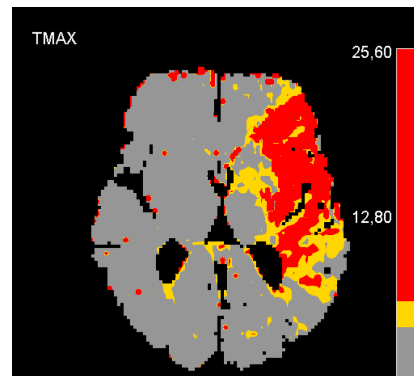


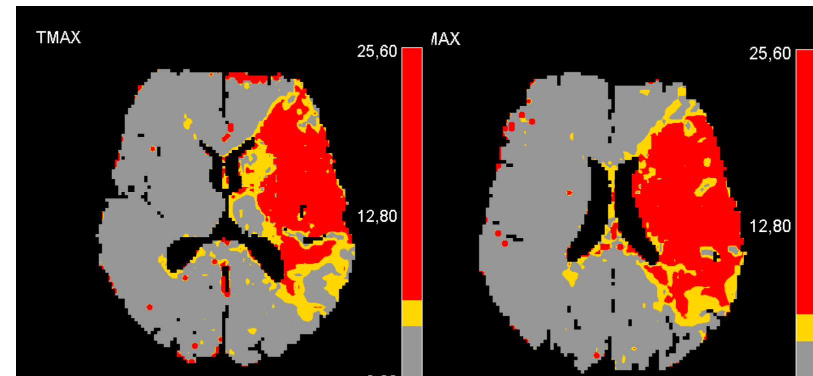
Perfusion



Mismatch = **Diffusion** **/** **Perfusion**

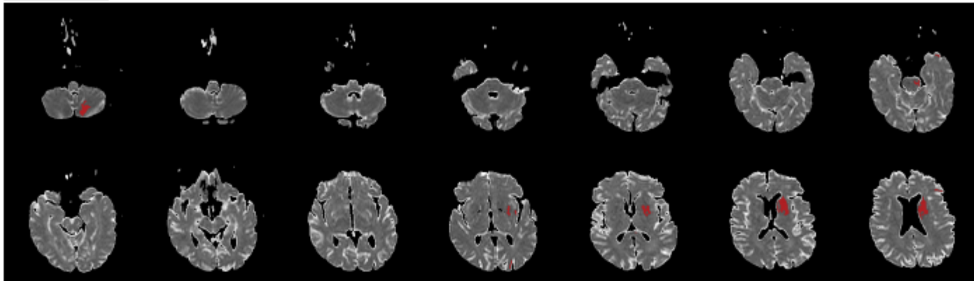




Mismatch ratio: VOLUME 2 / VOLUME 1 ; Mismatch volume: VOLUME 2 - VOLUME 1 ; Relative mismatch: (VOLUME 2 - VOLUME 1)/VOLUME 2 x 100

VOLUME 1

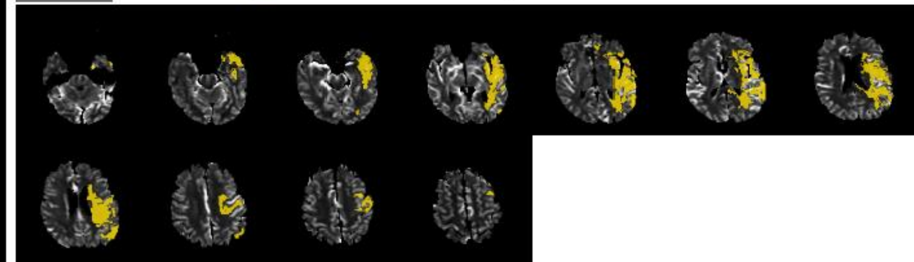
	aADC < 0.6 1e-3 mm²/s	5.58 cc



MR Report 2009 Sep 01 12:03 Patient: MR Stroke 2 ^OMVTD
Patient ID: wAwQwQAr M/M

VOLUME 2

	aTMAX > 6.0 s	98.27 cc

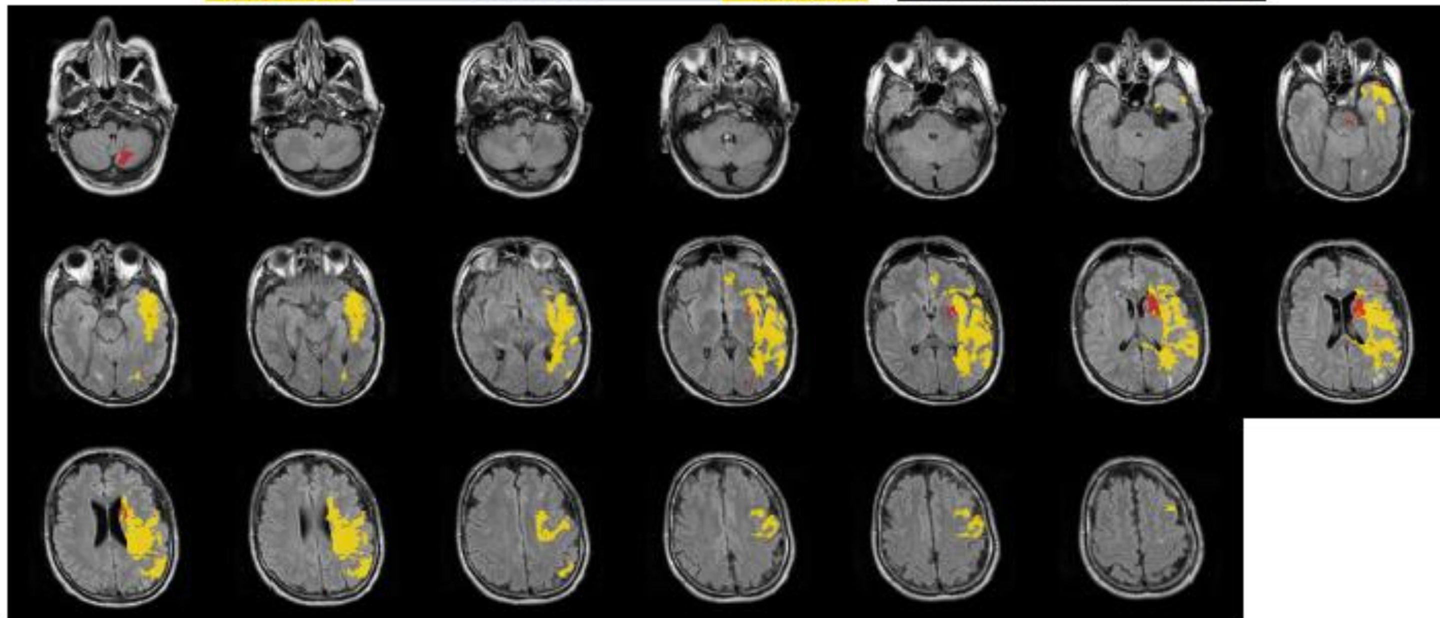


MR Report 2009 Sep 01 12:03 Patient: MR Stroke 2 ^OMVTD
Patient ID: wAwQwQAr M/M

OVERVIEW

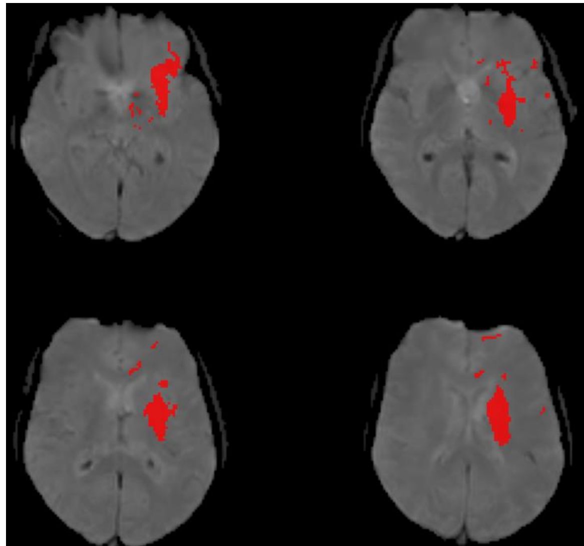
VOLUME 1	aADC < 0.6 1e-3 mm²/s	5.58 cc
VOLUME 2	aTMAX > 6.0 s	98.27 cc

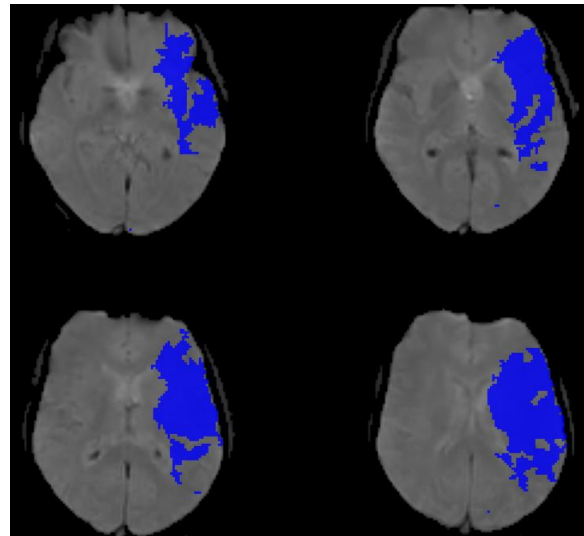
Mismatch ratio	17.6
Relative mismatch	94.32 %

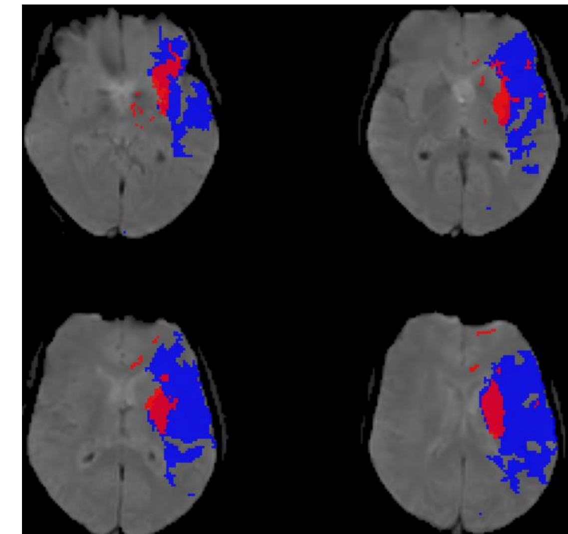


ADC

Tmax





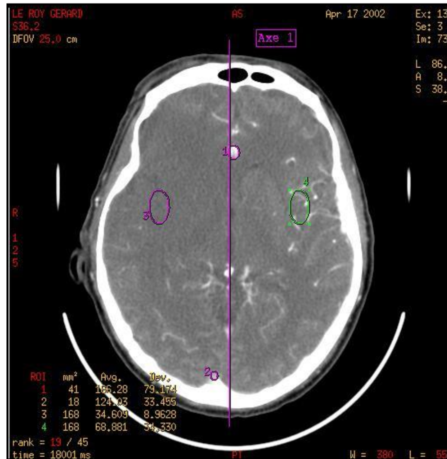


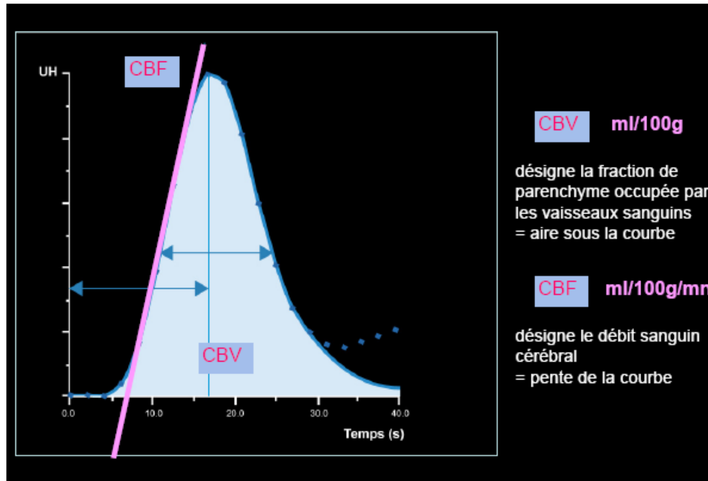
Mismatch : 6,11 Mismatch relatif= 83,64%

Catégorie	Série	Moyenne	Volume (cc)
hypoperfusé	TMAX	11,59	142,12
lésion	PERFUSION	561,39	23,25

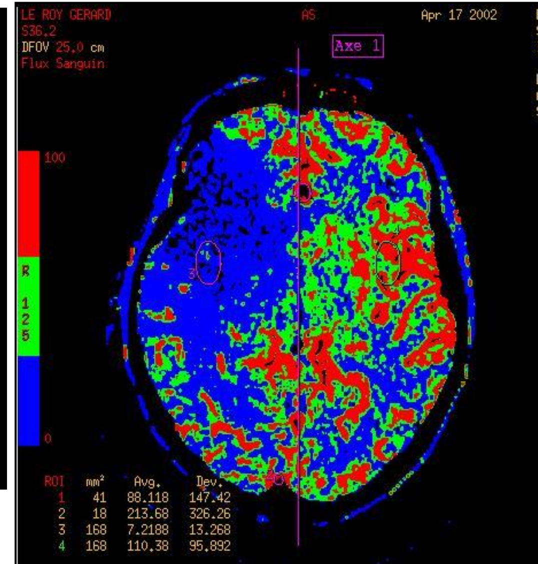
Au-delà de 6h

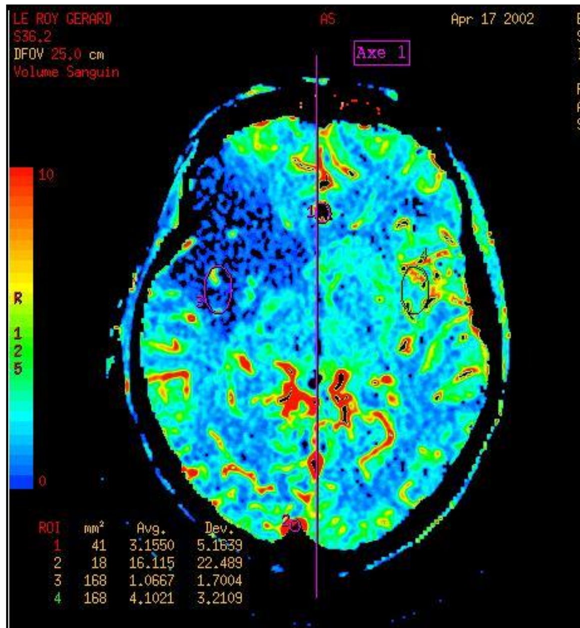
- Volume nécrose (ADC)< 70 ml
- Ratio tissu hypoperfusé(Tmax>6s) /tissu nécrosé > 1,8
- Volume hypoperfusé 15 ml ou +



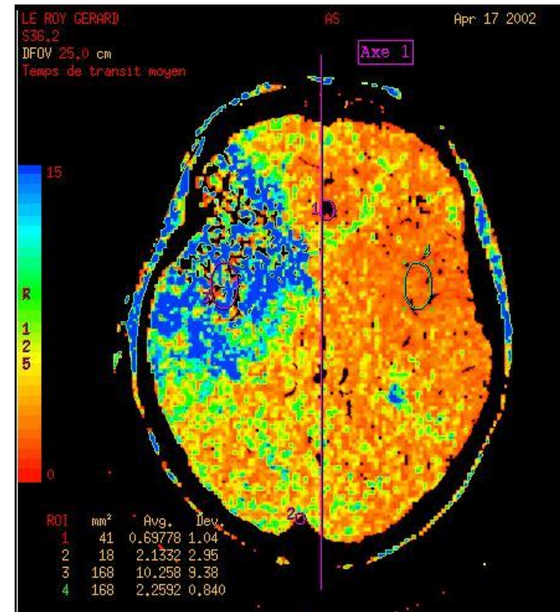


Débit sanguin régional

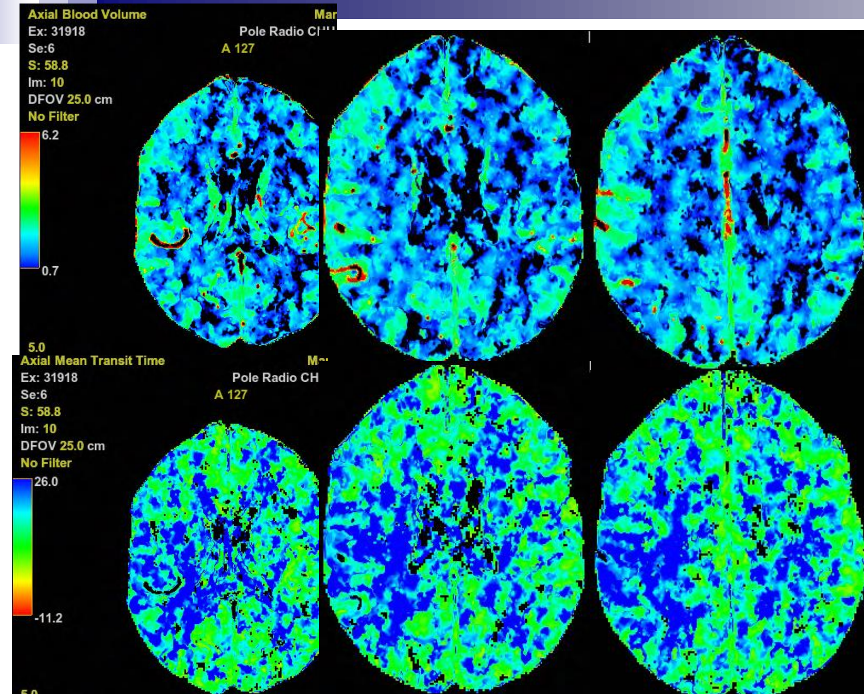


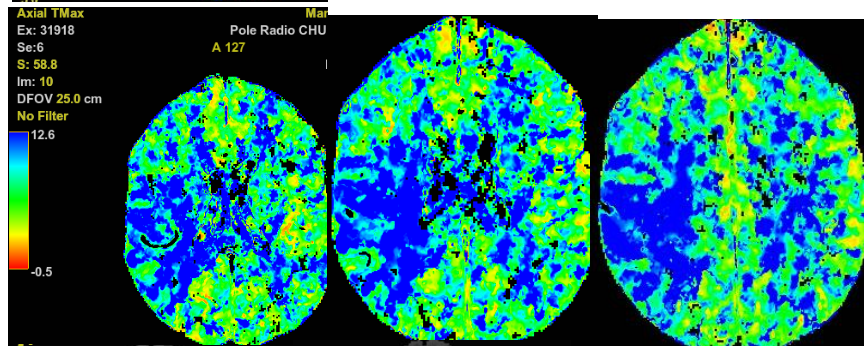


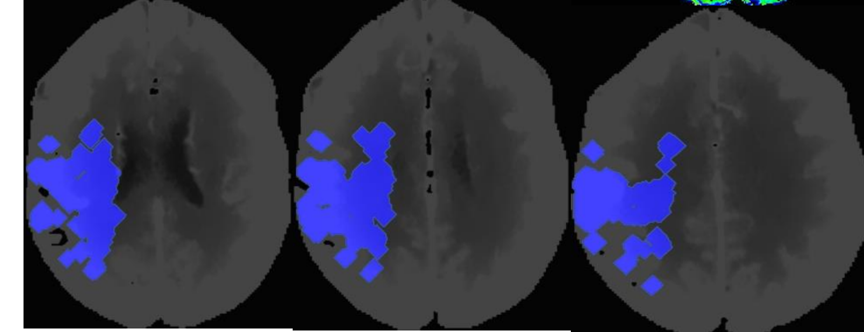
Volume sanguin régional



Tps de Transit Moyen







Carte de VSC = zone de nécrose, chute de 60% par rapport au côté controlatéral ou valeur absolue inférieure à 2ml/100g

TTM sup à 140% par rapport au côté controlatéral

Tmax > 6sec

Classification des tissus = mismatch

Collatérales

Bonnes collatérales :

- AIC de petite taille
- Mismatch plus élevé
- Différencient slow / fast progressors
- Diminuent le risque hémorragique

Regional leptomeningeal collateral score by computed tomographic angiography correlates with 3-month clinical outcome in acute ischemic stroke

Chatterjee et al,Brain circulation,2020

CTA collateral score predicts infarct volume and clinical outcome after endovascular therapy for acute ischemic stroke: a retrospective chart review

Elijivich et al, J.Neurointerv.Surg 2020

Better Collaterals Are Independently Associated With Post-Thrombolysis Recanalization Before Thrombectomy

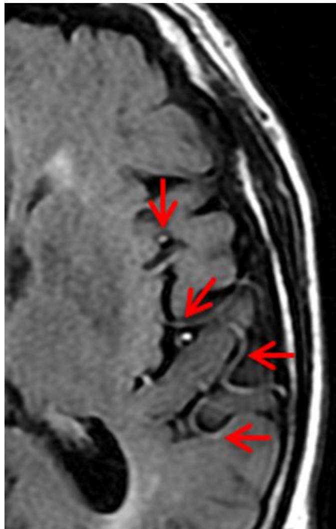
Seners et al,Stroke 2019

13. 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

Collatérales

IRM : FLAIR

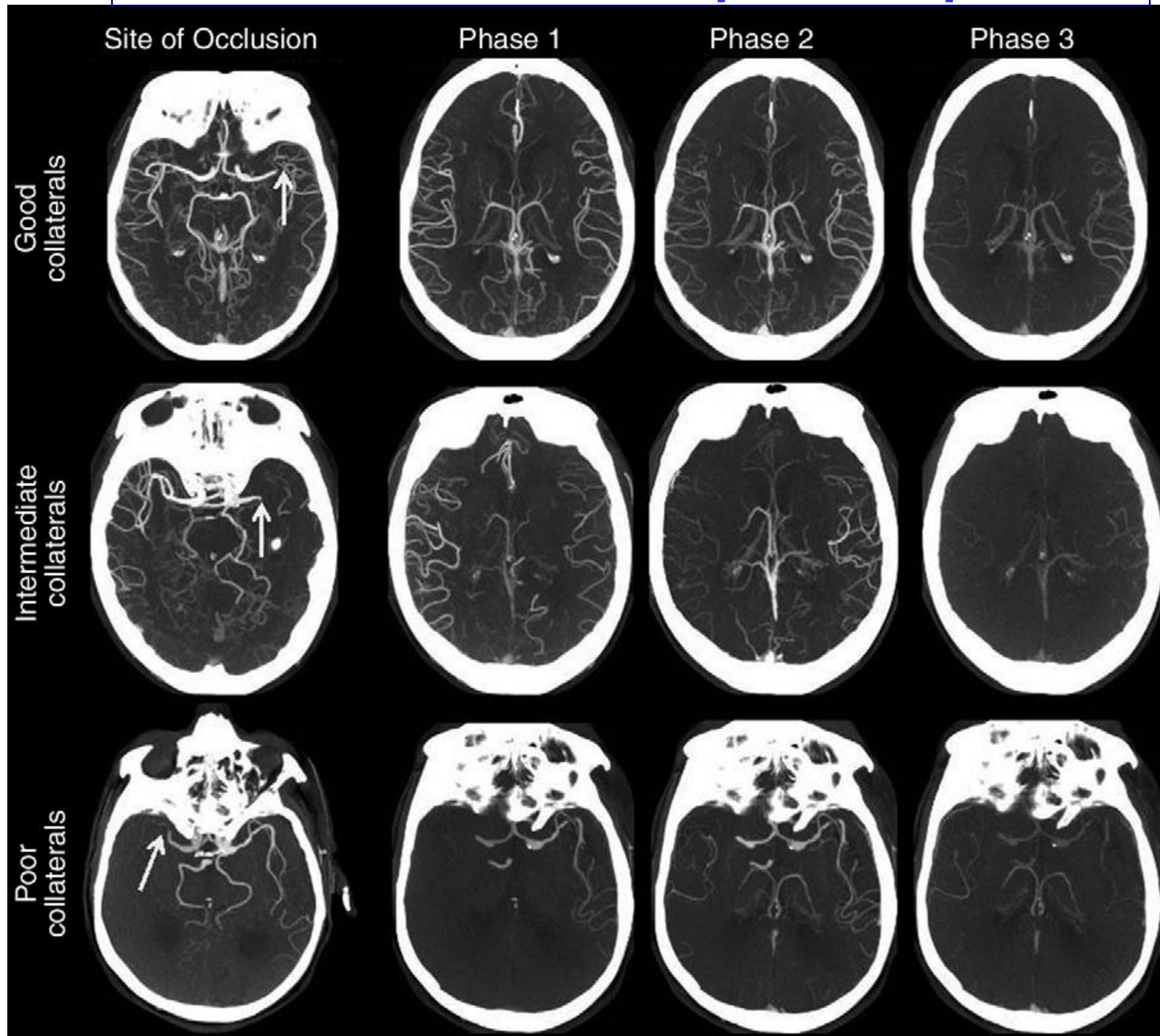
Hypersignal FLAIR
Flux vasculaire ralenti
Signe du « spaghetti »



TDM : multiphasique

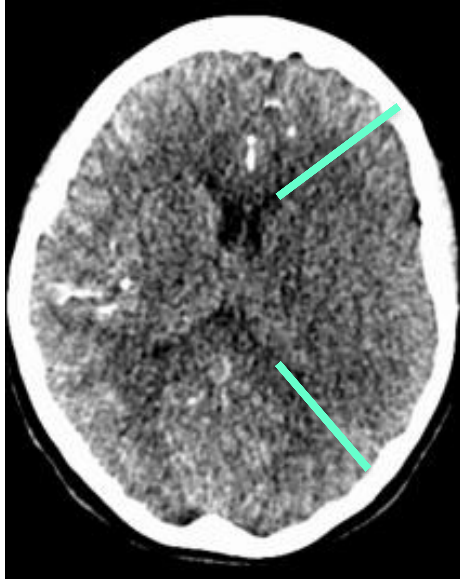
- 1ère acquisition TSA de la crosse au vertex
- 2 autres acquisitions de la base du crâne au vertex
- Durée ≈ 22s

Scanner multiphasique

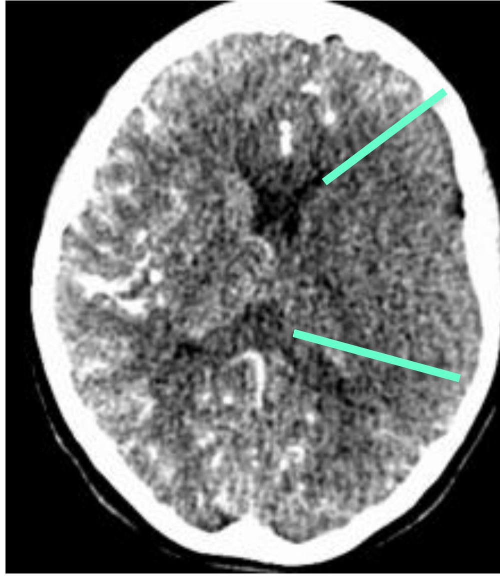


Menon Radiology 2015

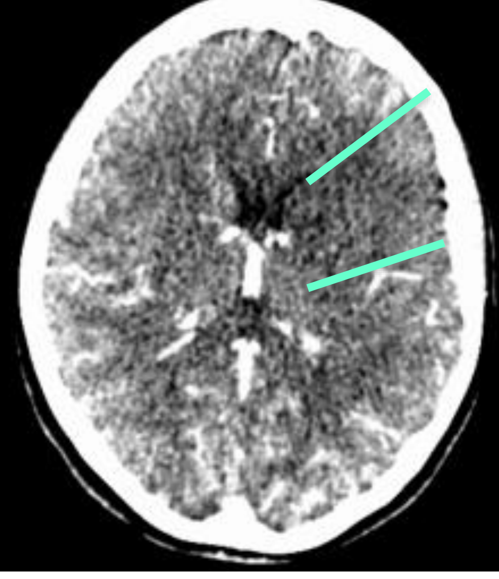
Scanner multiphasique



Précoce

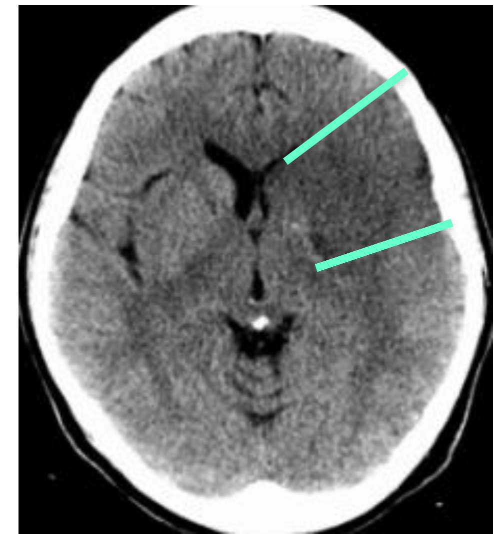


Intermédiaire



Tardif

Contrôle TDM 72h



Parameters	CT	MR	Preferred modality
General	Irradiation (5-10mS) Iode	Gadolinium (Nephrogenic systemic fibrosis)	MRI
Feasibility	Greater Availability 10-15 min / exam	Less Availability/ Contrindications 15-20 min / exam	CT
Scientific validation	Scarce	Rich	MRI
Infarct core	Plain CT, CTA source images, CBV maps	DWI >> any CT options	MRI
Penumbra	In theory, CT Perfusion more valid/ 4 cm coverage	Correlation with PET and Xenon/ Whole brain coverage	CT ≈ MRI
Vessels status	Accurate for intracranial arteries Artefacts at the arch	Flow artefacts causes false Postive stenoses and occlusion	CT

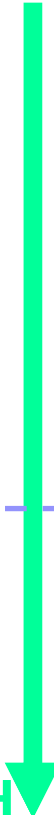
AVC du réveil

Adapted from Köhrmann et al. Radiology. June 2009

IMAGERIE AVC

- IRM (HAS)
  - T2*
  - Diffusion
  - FLAIR
  - ARM
  - Perfusion

< 10mn



- TDM
  - Sans IV
  - Angio TSA
  - CT multiphases
  - Perfusion

Conclusion

- Diagnostic +, site de l’occlusion : TDM/IRM + angioTSA
- AVC du réveil : IRM++
- Après 6h : perfusion (tissu à sauver)
- Concertation neurologue/neuroradiologue