



# Thrombectomie : imagerie pré- opératoire

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**Diffusion**

**Perfusion**

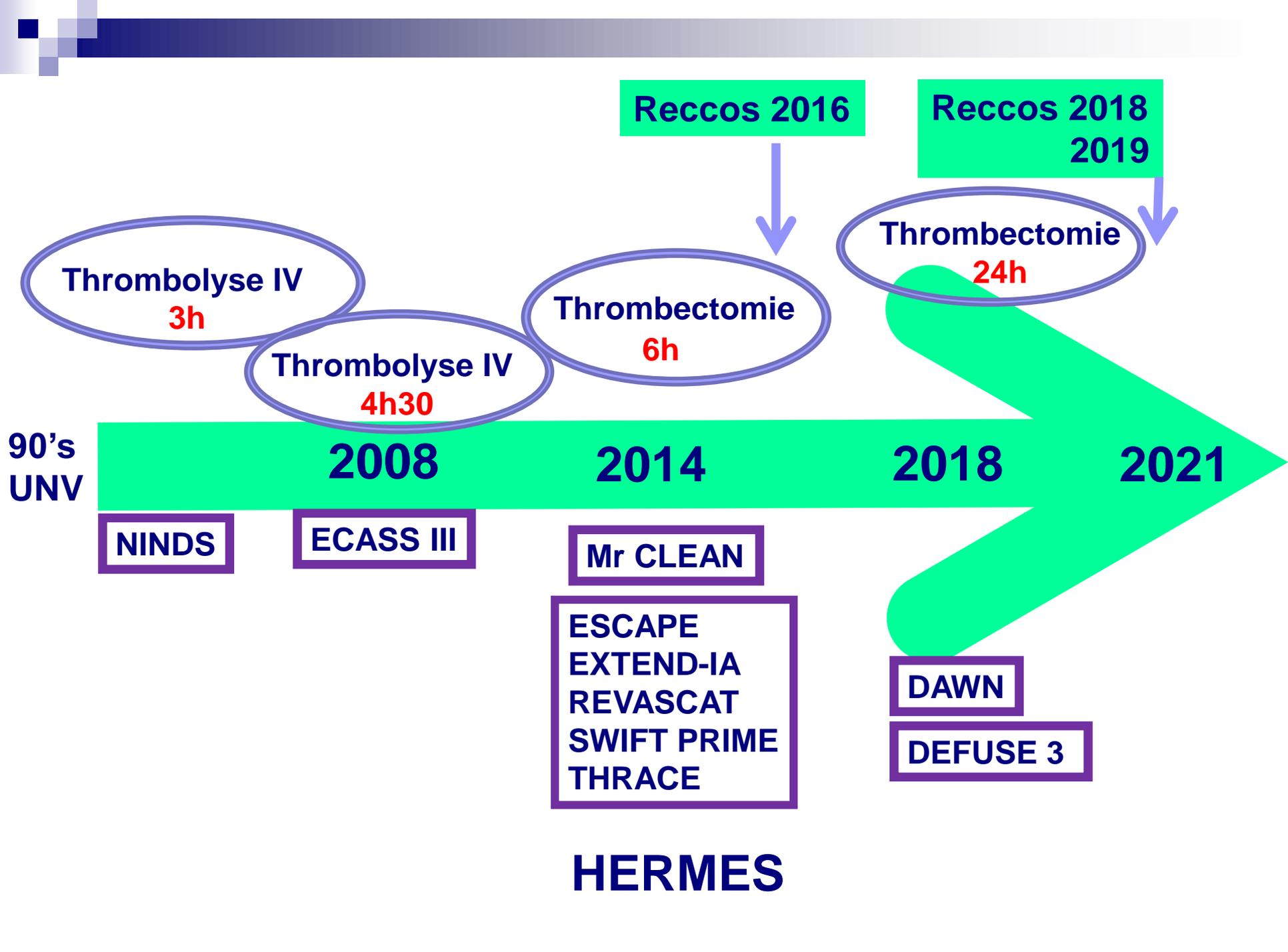
**TDM**

**IRM**

**ASPECTS**

**TSA**





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 WSO

International Journal of Stroke  
2016, Vol. 11(1) 134-147  
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DOI: 10.1177/1747493016638778  
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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

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

EUROPEAN  
STROKE JOURNAL

European Stroke Journal  
2019, Vol. 4(4) 207-217  
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2019  
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DOI: 10.1177/2396987318813466  
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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

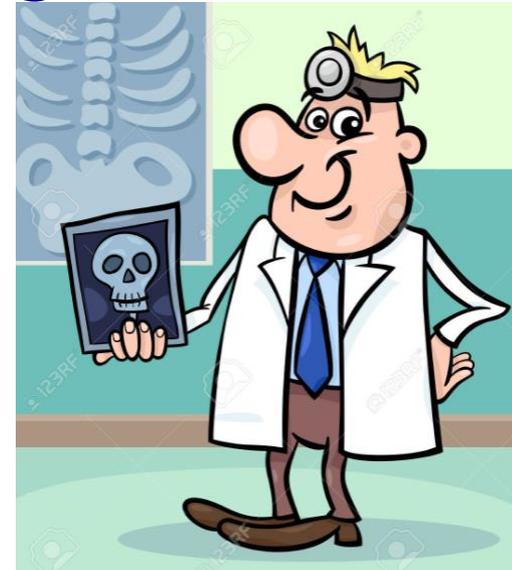
## ■ Diagnostic +

- 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

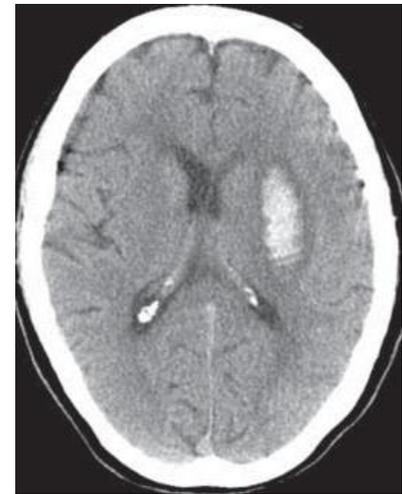
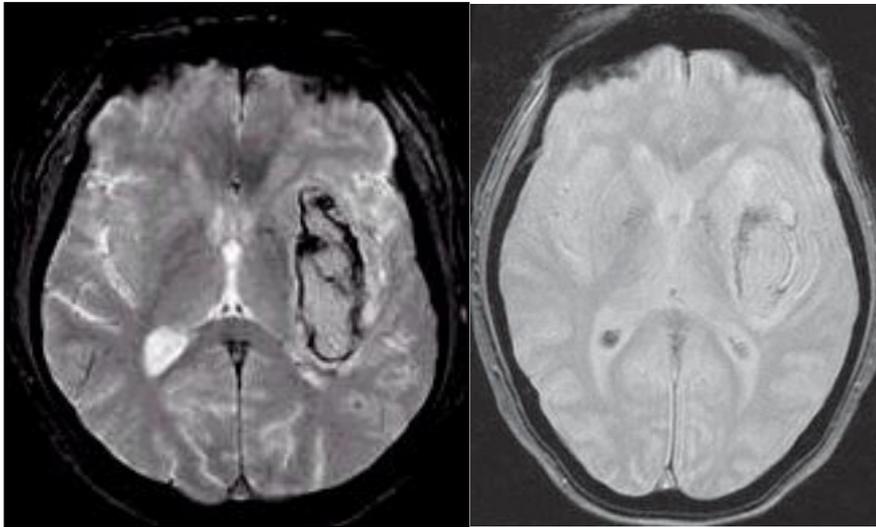
**TISSU  
A SAUVER**  
> 6h



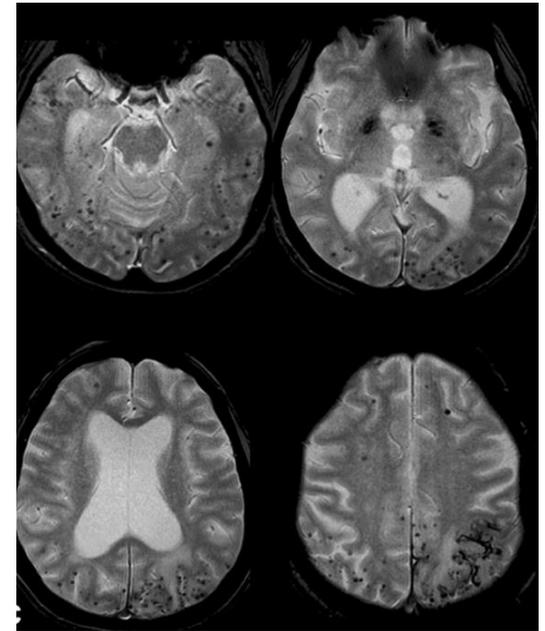
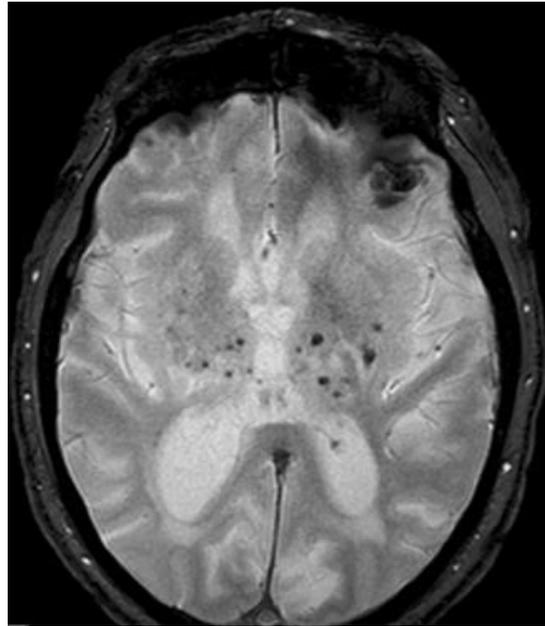
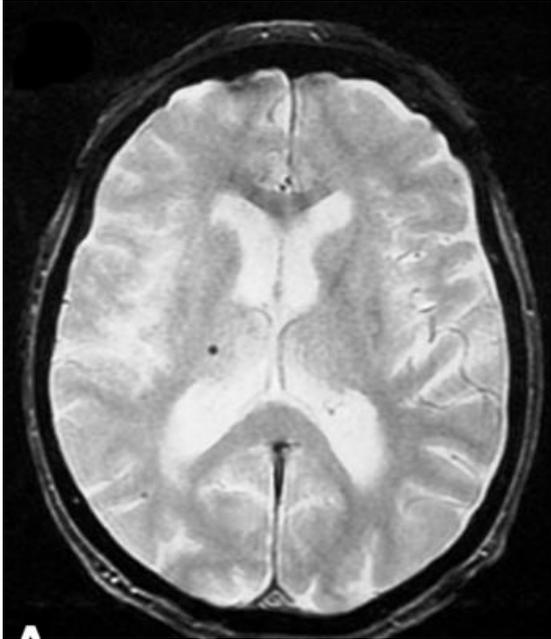
# Diagnostic + : exclure l'hématome

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

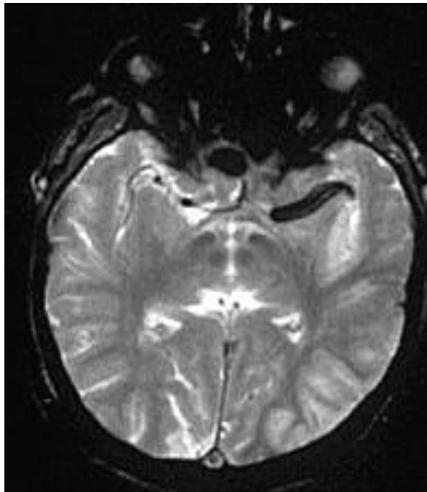
B-NR

# Diagnostic + : confirmer l'AVC

Visualisation du thrombus

IRM : T2\*

Susceptibility Vessel Sign



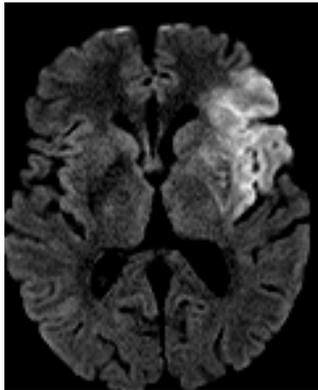
TDM : sans IV

Artère hyperdense  
(« trop belle artère »)

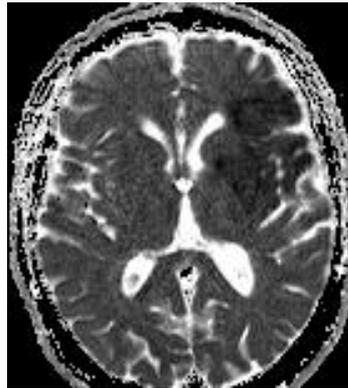


# Diagnostic + : confirmer l'AVC

IRM : Diffusion

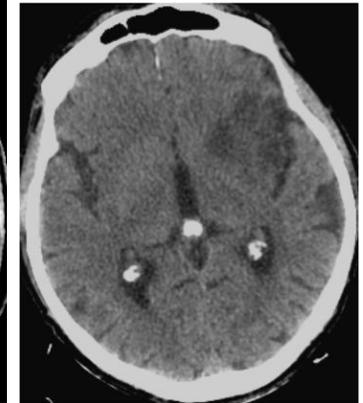
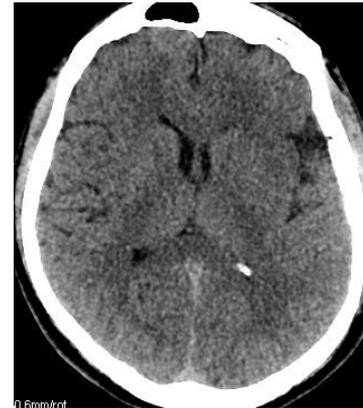


b1000

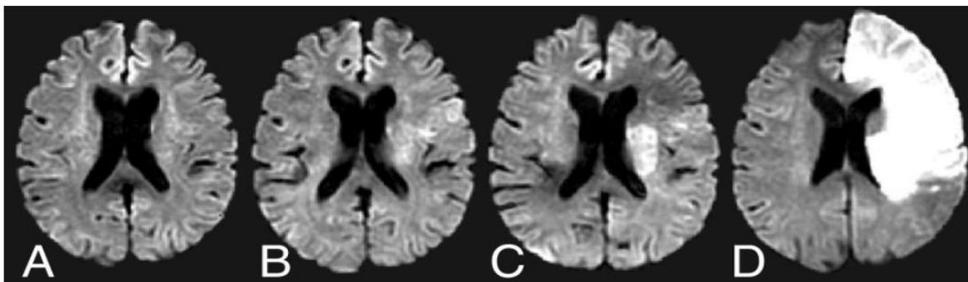


ADC

TDM : sans IV



Précocé+++



Before deficit

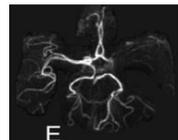
+ 11 min

+ 3h

+ 24h

Ischemic Injury Detected by Diffusion Imaging 11 Minutes after Stroke

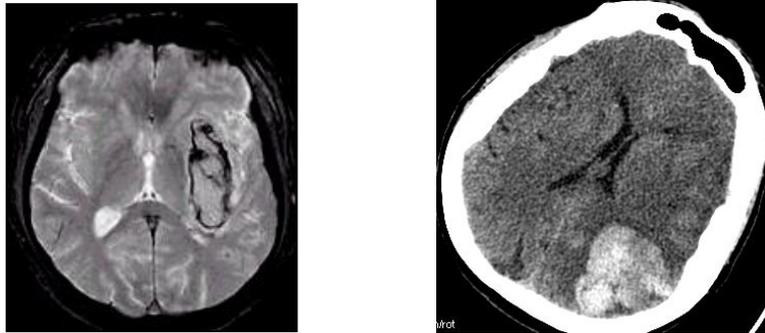
Niels Hjort, MD,<sup>1,2</sup> Søren Christensen, MSc,<sup>1</sup> Christine Sølling, MD,<sup>1</sup> Mahmoud Ashkanian, MD,<sup>1</sup> Ona Wu, PhD,<sup>2</sup> Lisbeth Rohlf, MD, PhD,<sup>1</sup> Carsten Gyldensted, MD, PhD,<sup>1</sup> Grethe Andersen, MD, PhD,<sup>2</sup> and Leif Østergaard, MD, PhD<sup>1</sup>



E

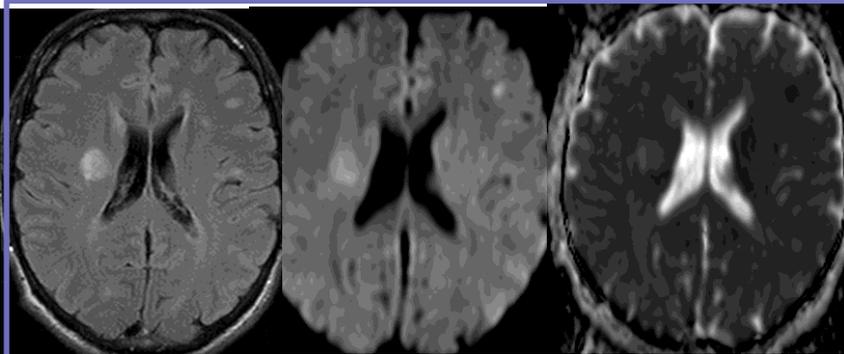
- Normal
- Perte de différenciation gris/blanc :
  - Noyaux gris centraux
  - Ruban insulaire
- Effacement des sillons
- Hypodensité franche

# Diagnostic différentiel



Hématome+++

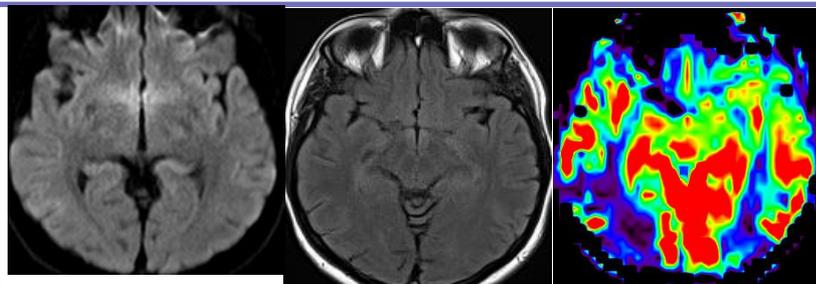
TDM / IRM



SEP

Poussée de SEP  
Aura migraineuse  
EPPR  
Thrombophlébite  
MELAS,,,

→ IRM++

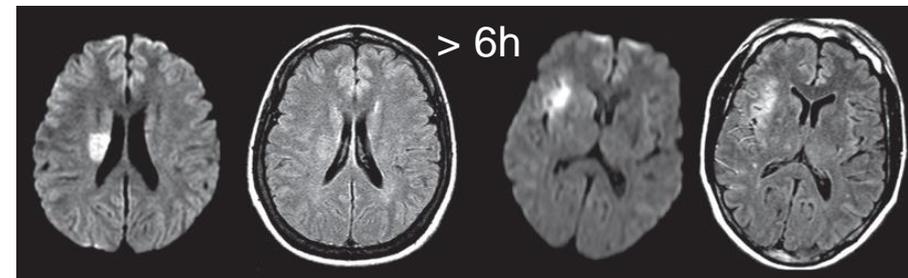
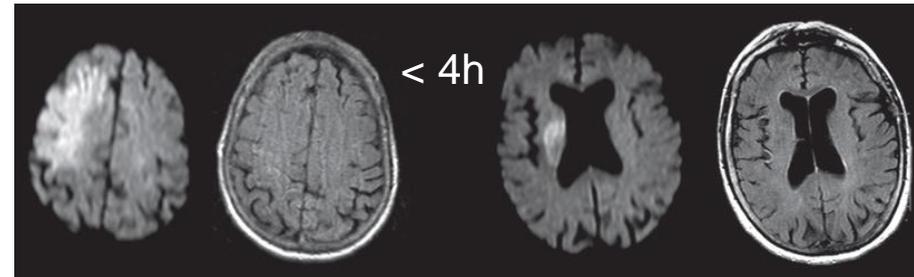


Aura migraineuse

# Caractérisation de l'infarctus : ancienneté

## IRM : FLAIR

- Signes parenchymateux:
  - Apparaissent entre 4 et 6h

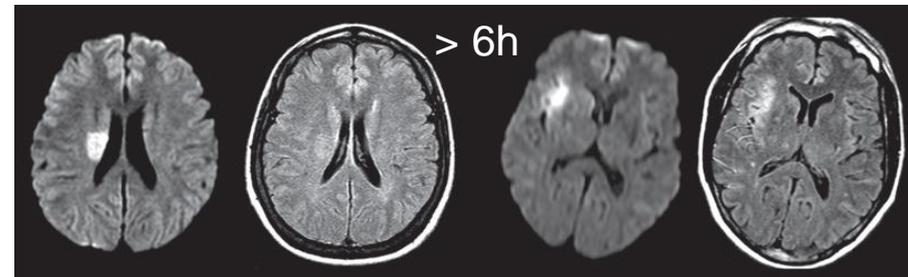
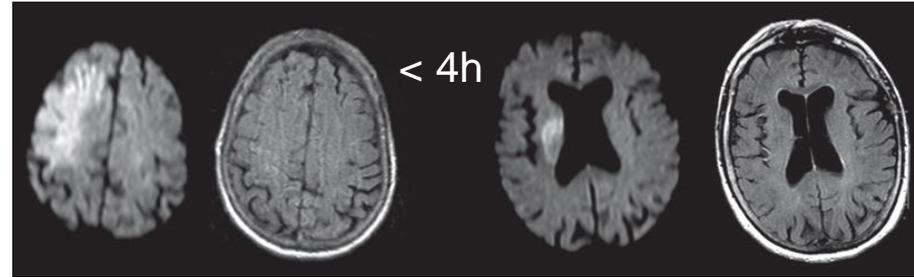


- Comparaison FLAIR/diff permet d'évaluer l'ancienneté (AVC du réveil ++, heure de début des symptômes inconnue)

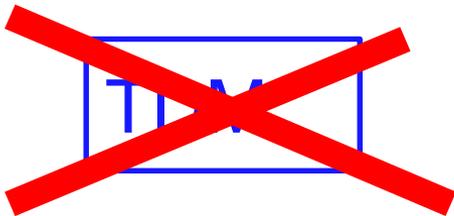
# Caractérisation de l'infarctus : ancienneté

## IRM : FLAIR

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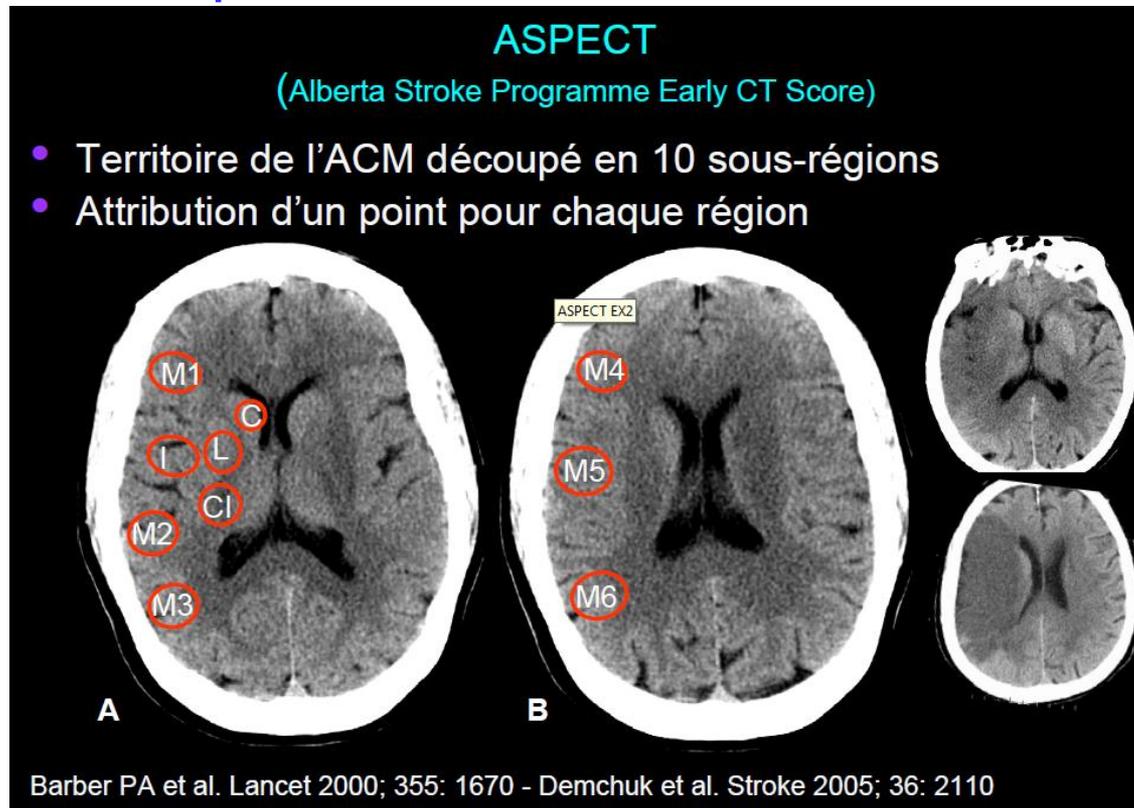
- Comparaison FLAIR/diff permet d'évaluer l'ancienneté (AVC du réveil ++, heure de début des symptômes inconnue)



AVC du réveil : IRM

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

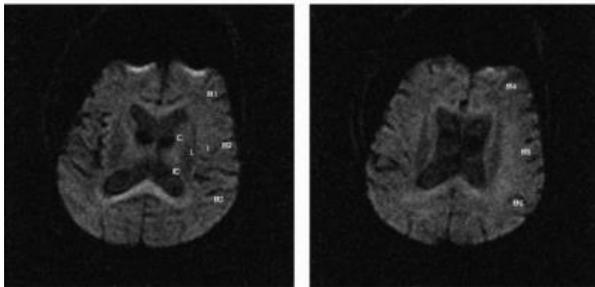
- Facteur pronostic
- Profil malin : transformation hémorragique, mauvaise évolution clinique



# Caractérisation de l'infarctus : core

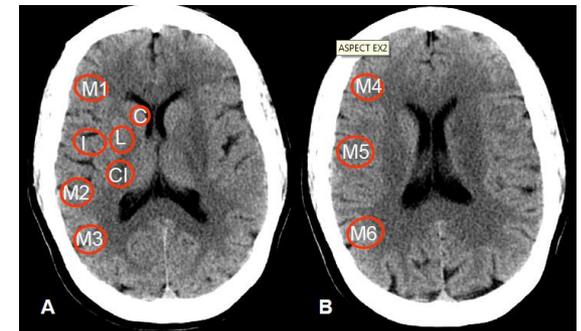
IRM : Diffusion

ASPECT DWI  $\leq 5$

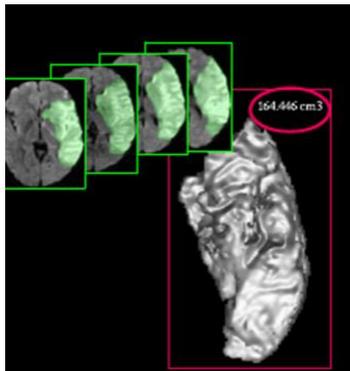


TDM : sans IV

Score ASPECT  $\leq 7$

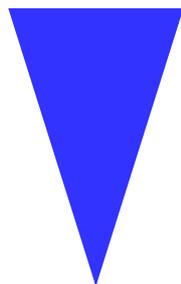


Volume > 100ml (DWI) ,70 ml (PWI  
(Tmax >6))



# 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)**

# Caractérisation de l'infarctus : site d'occlusion

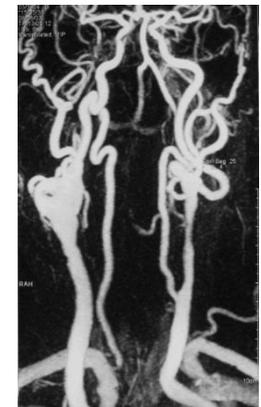
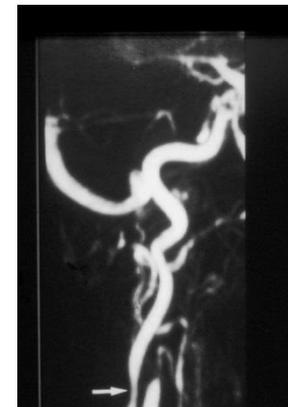
## ARM

### ■ 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.

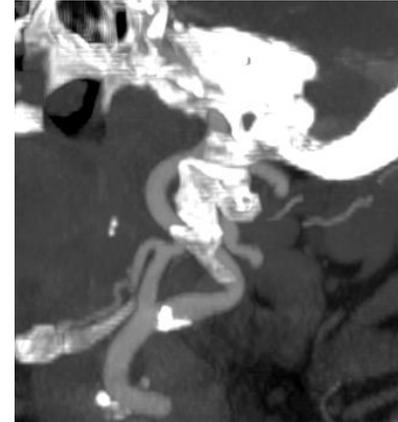
IIa

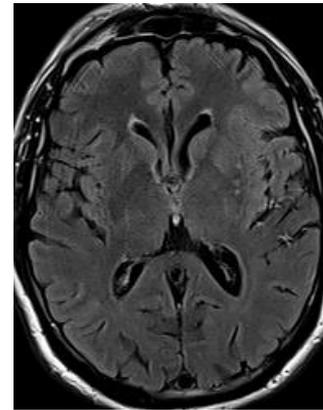
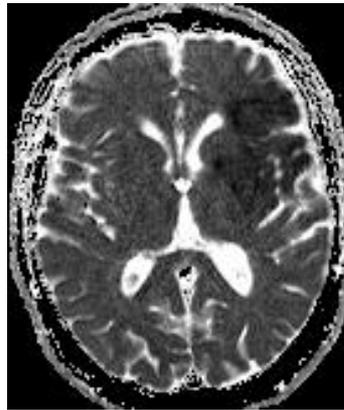
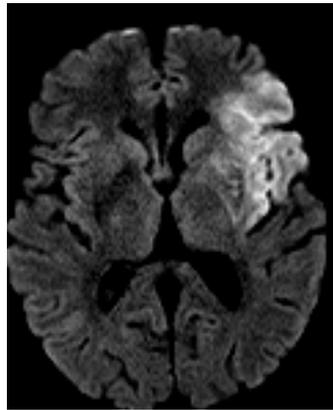
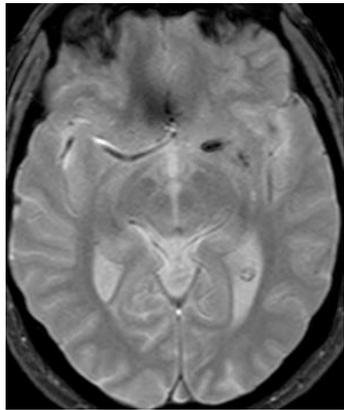
C-E0

# Caractérisation de l'infarctus : site d'occlusion

## AngioTDM

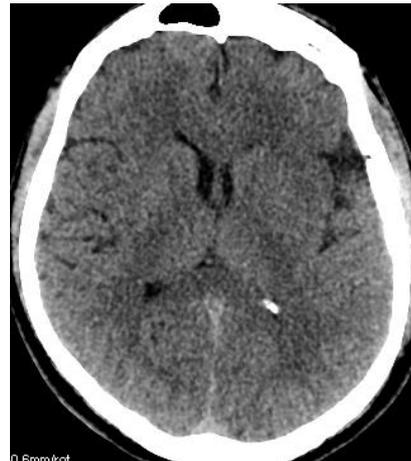
TSA+polygone  
Site de l'occlusion  
Etat de la vascularisation d'amont





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

## Mismatch clincoradiologique



# 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

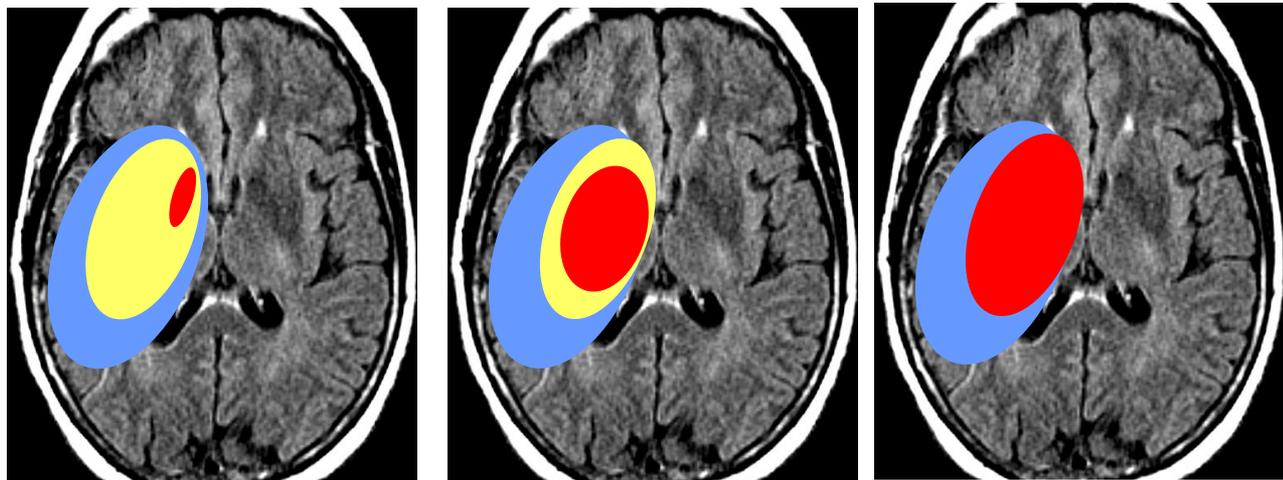
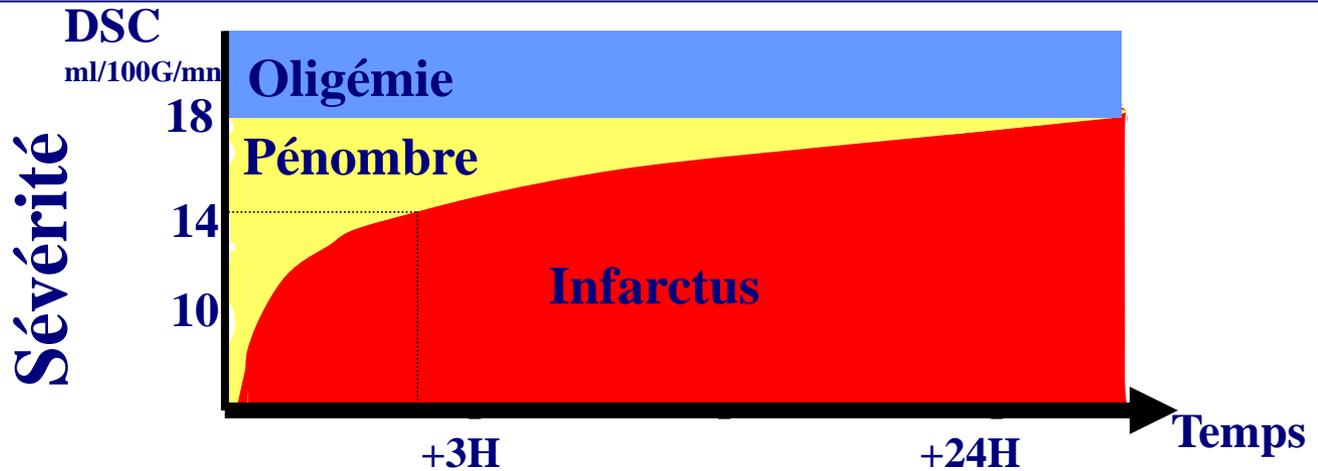
- Perfusion : intérêt discuté < 6h
- Nécessaire si
  - Délai > 6h
  - Clinique atypique
  - IRM Diffusion normale

# Perfusion

<p>11. Additional imaging beyond CT and CTA or MRI and magnetic resonance angiography (MRA) such as perfusion studies for selecting patients for mechanical thrombectomy <b>in &lt;6 hours is not recommended.</b></p>	<p>III: No Benefit</p>	<p>B-R</p>	<p>New recommendation.</p>
<p>2.2. Brain Imaging (Continued)</p>	<p>COR</p>	<p>LOE</p>	<p>New, Revised, or Unchanged</p>
<p>12. In selected patients with AIS with <b>in 6 to 24 hours of</b> 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.</p>	<p>I</p>	<p>A</p>	<p>New recommendation.</p>

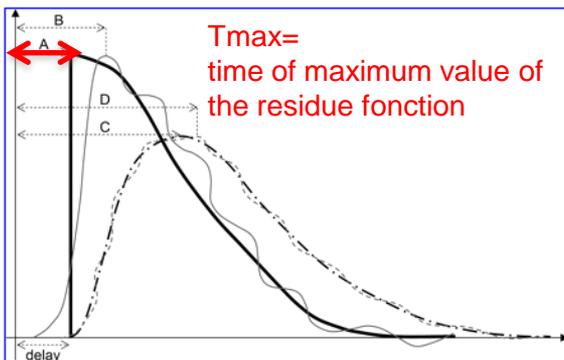
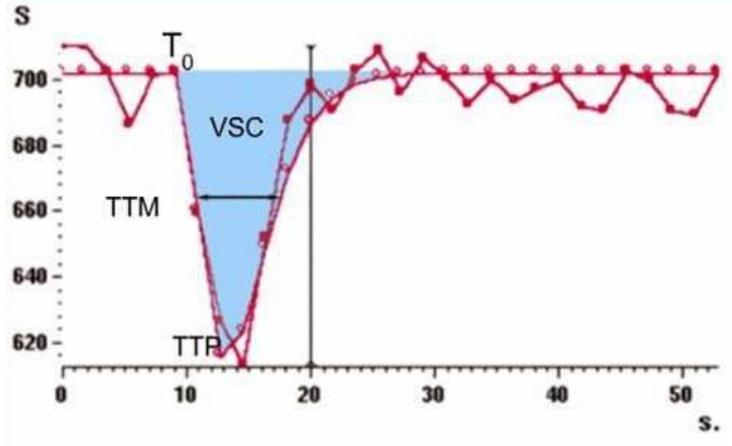
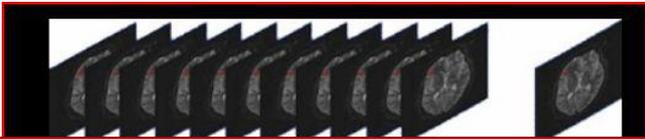
# Perfusion

## Evaluer l'étendue de la pénombre



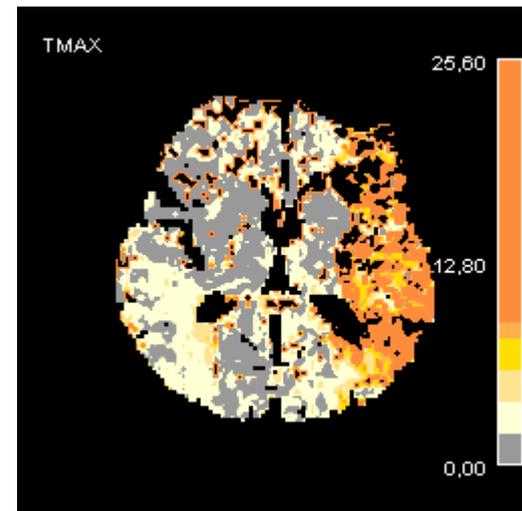
# IRM Perfusion

Etude du 1<sup>er</sup> passage d'un chélate de Gadolinium

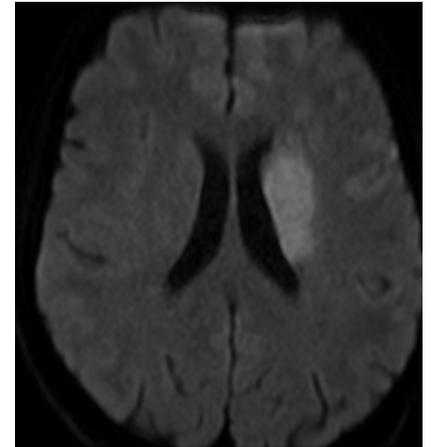
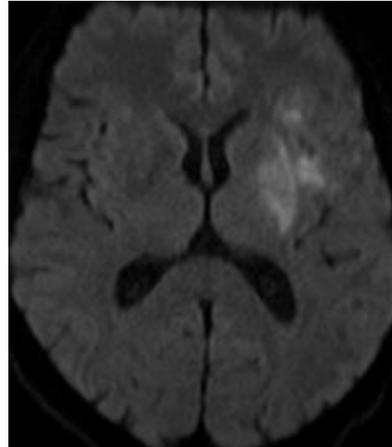
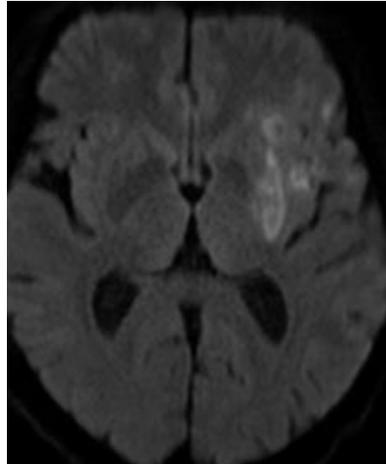
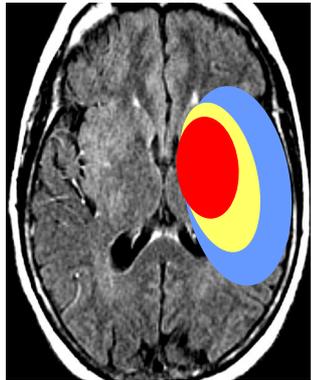


**Tmax > 6 s**

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



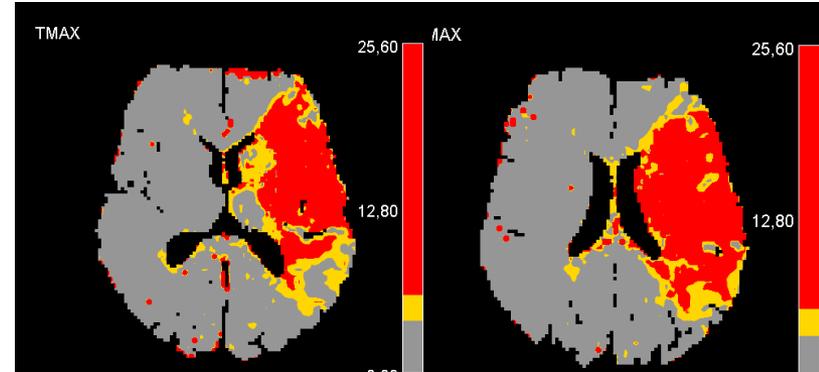
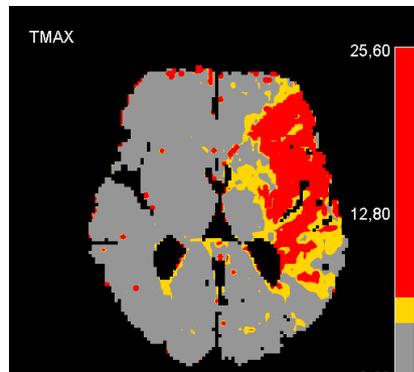
# Perfusion



**Diffusion**

Mismatch =

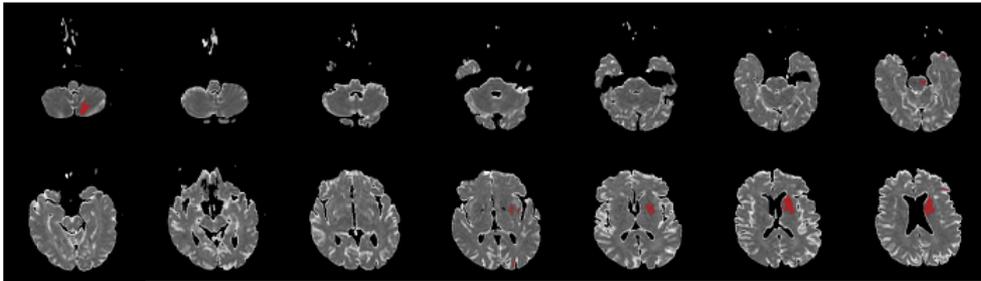
**/**  
**Perfusion**



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

VOLUME 1

**aADC < 0.6 1e-3 mm²/s**      **5.58 cc**



MR Report

2009 Sep 01 12:03

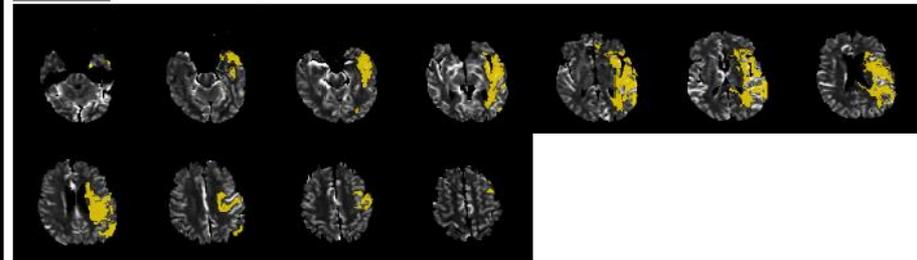
Patient: MR Stroke 2 ^OM/VD  
Patient ID: wAwQwQAr

M/M



VOLUME 2

**aTMAX > 6.0 s**      **98.27 cc**



MR Report

2009 Sep 01 12:03

Patient: MR Stroke 2 ^OM/VD  
Patient ID: wAwQwQAr

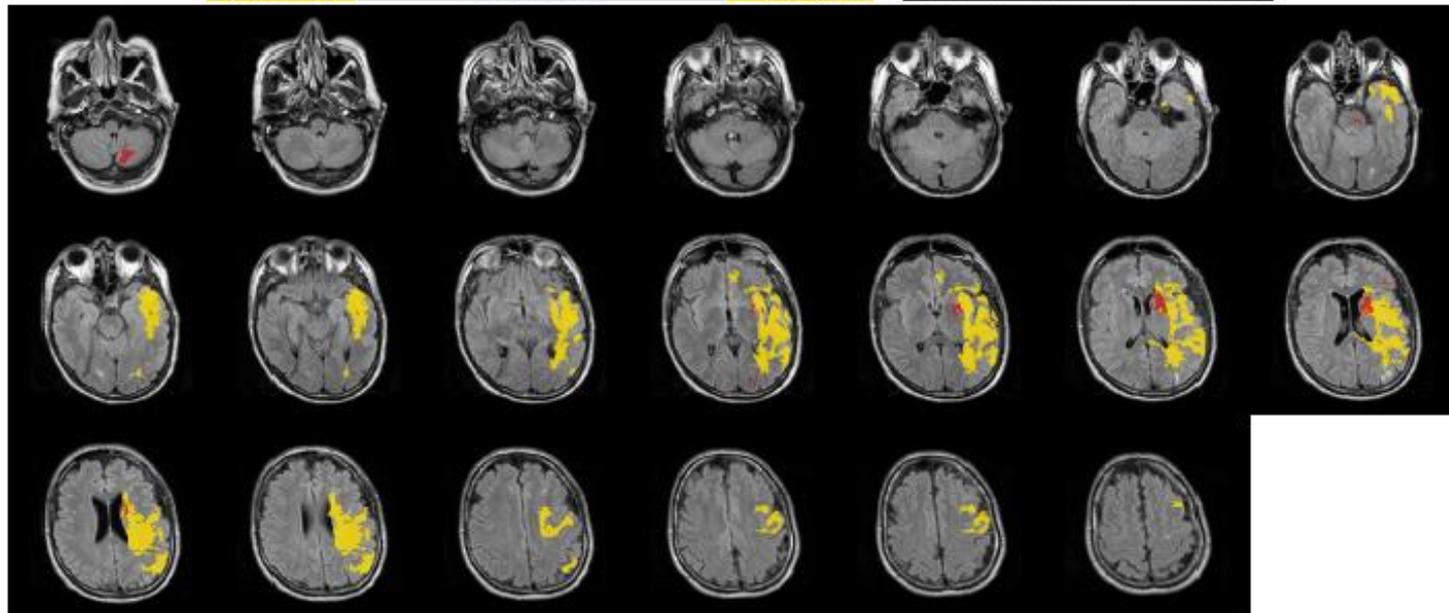
M/M



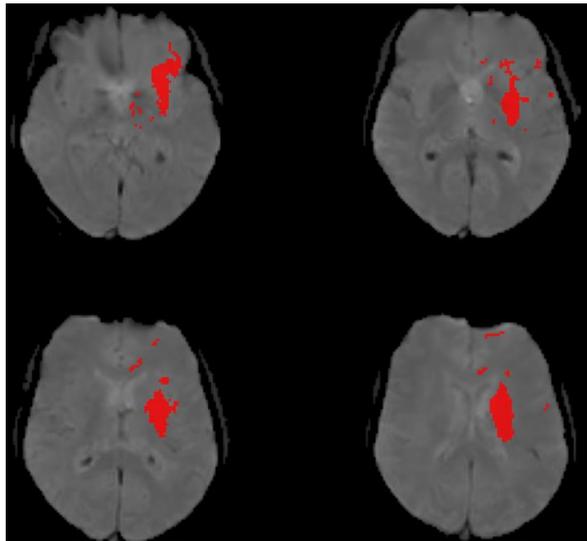
OVERVIEW

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

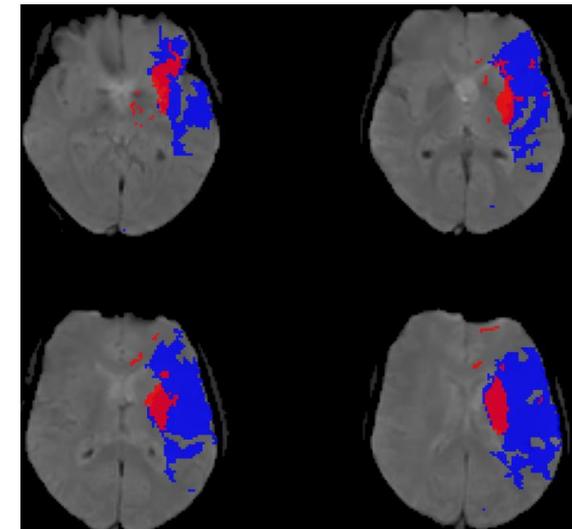
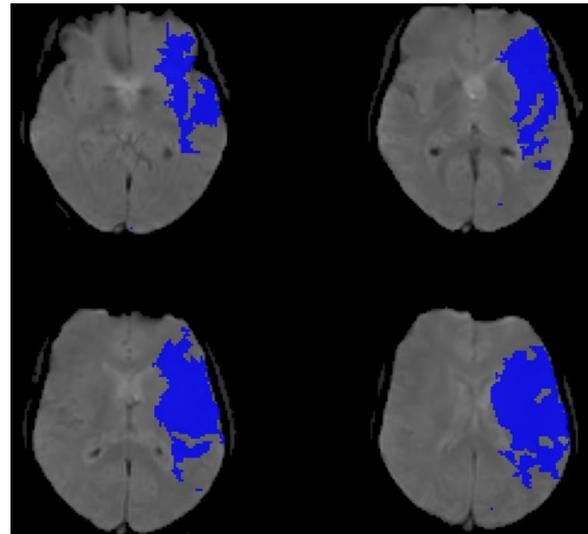
Mismatch ratio	17.6
Relative mismatch	94.32 %



ADC



Tmax



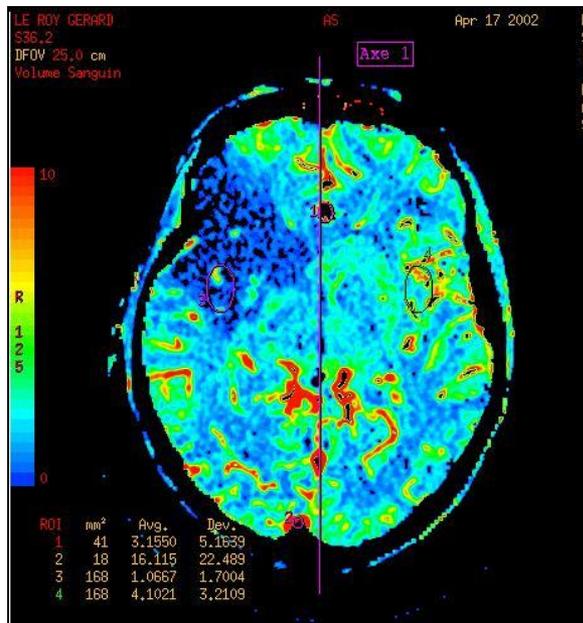
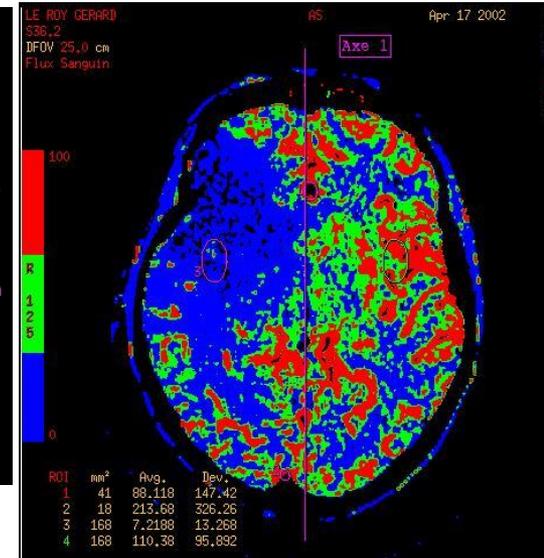
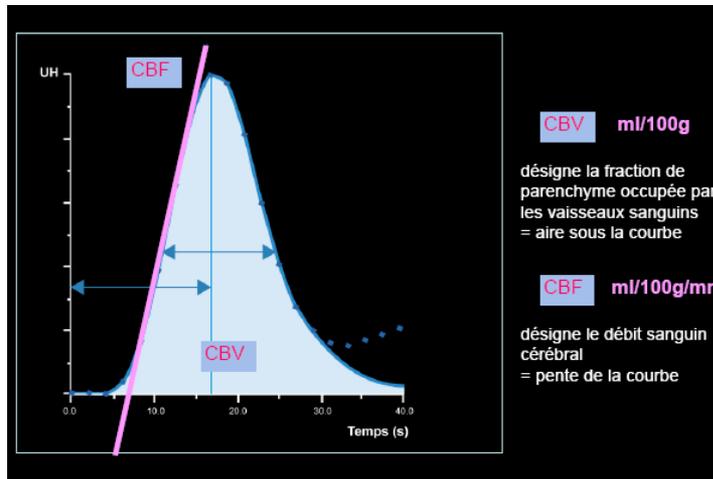
Mismatch : 6,11 Mismatch relatif= 83,64%

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

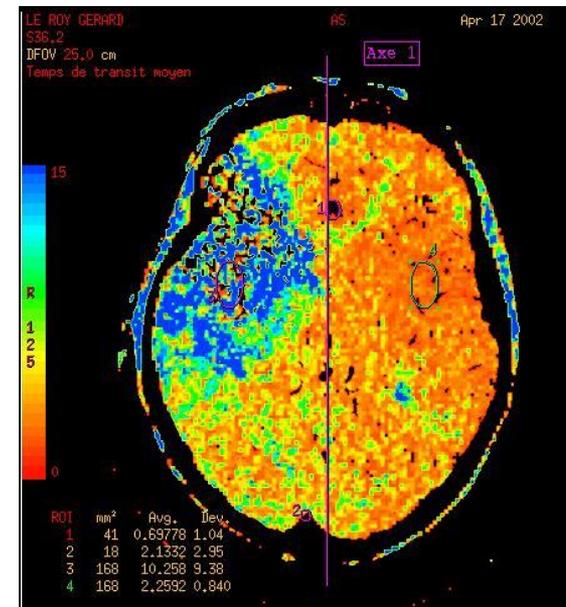
Au-delà de 6h

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

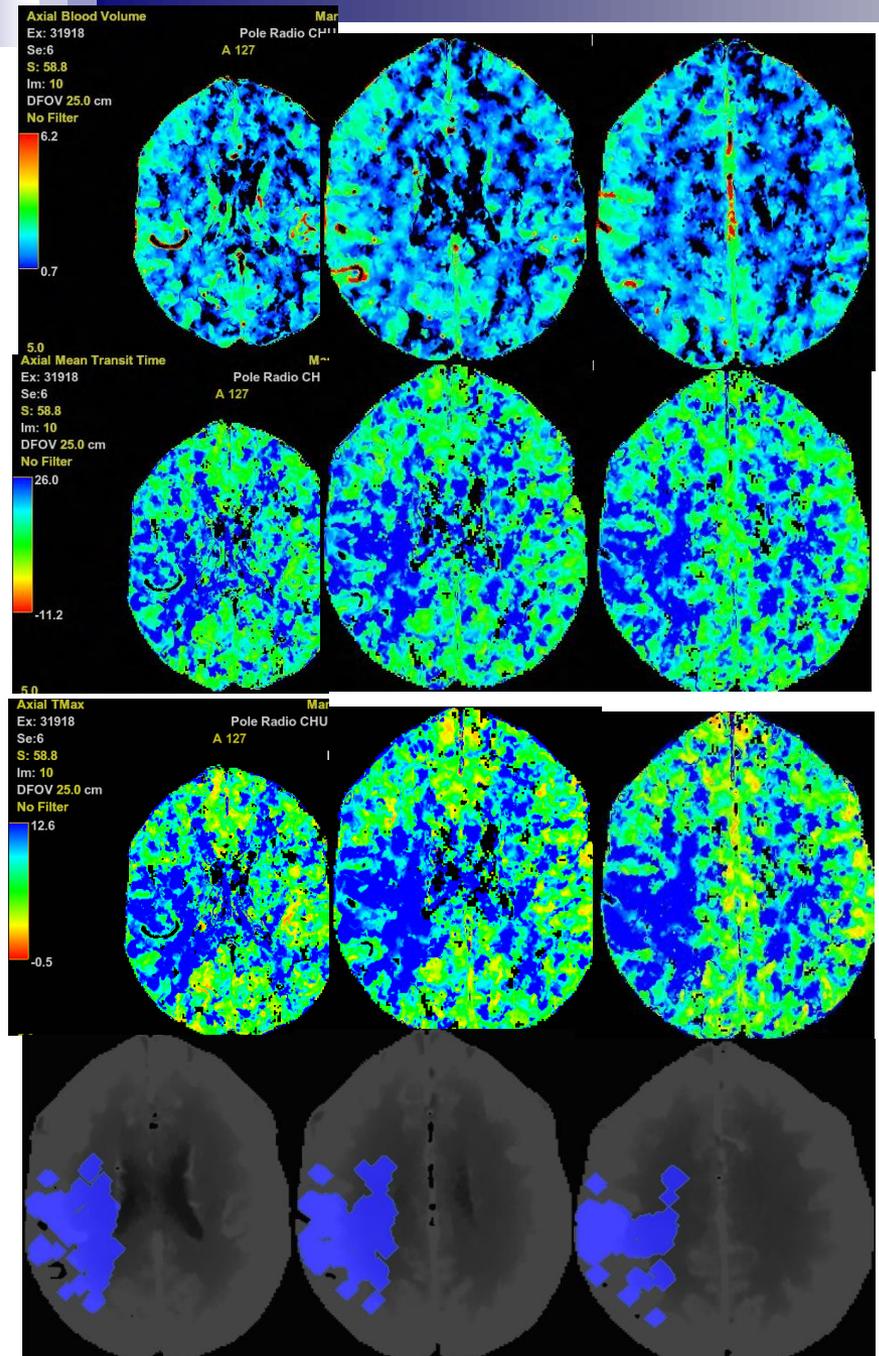
# Débit sanguin régional



**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

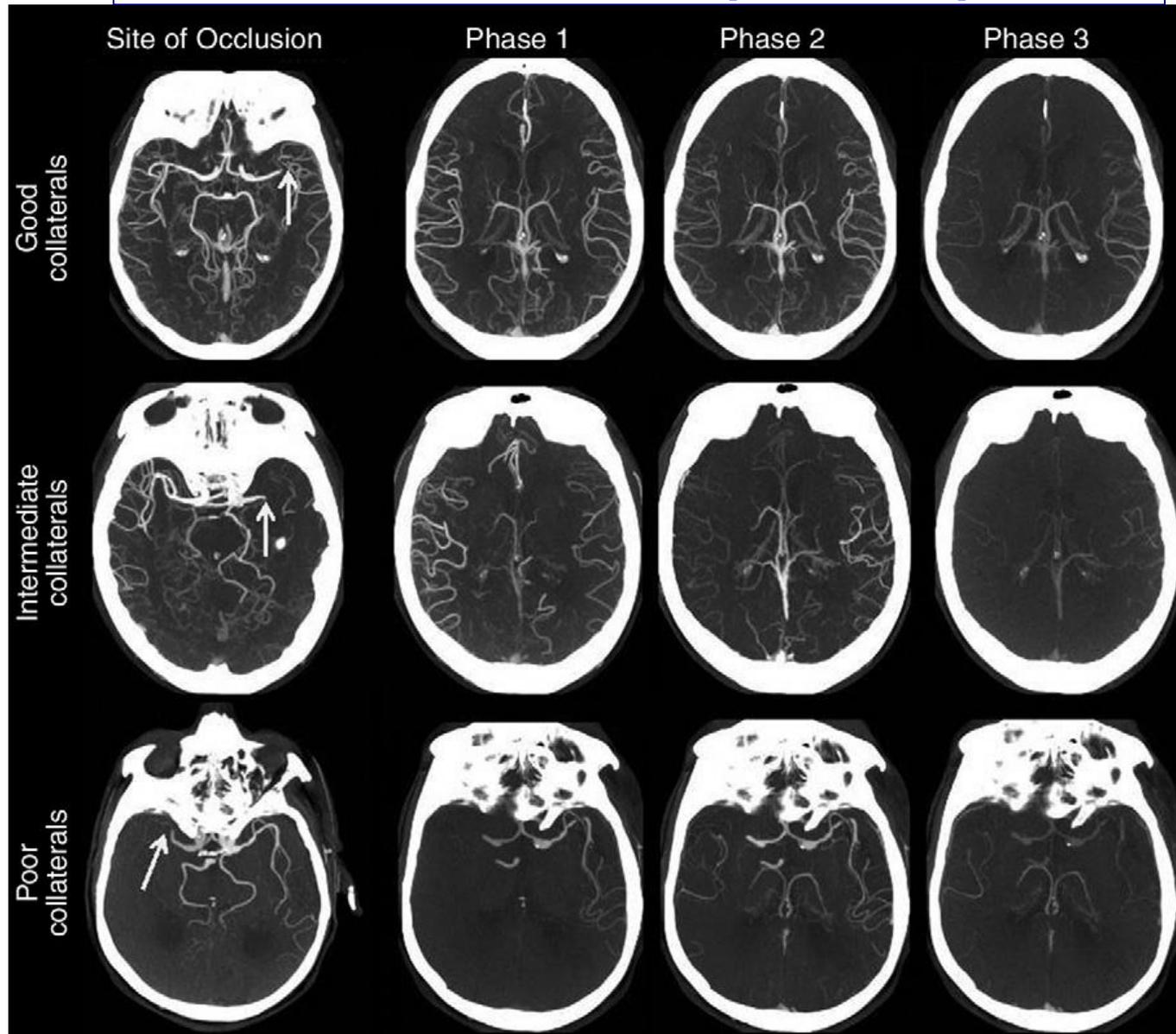
Hypersignal FLAIR  
Flux vasculaire ralenti  
Signe du « spaghetti »



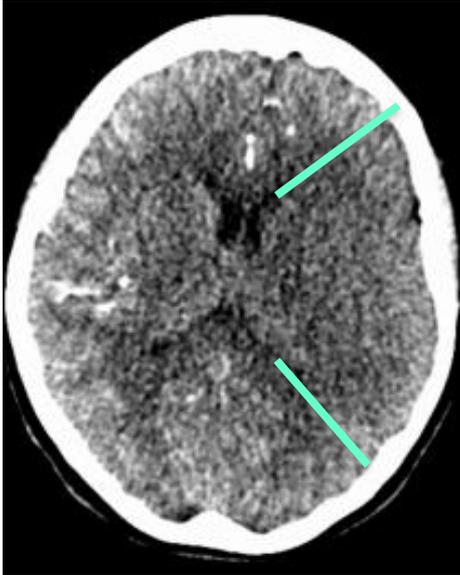
TDM : multiphasique

- 1<sup>ère</sup> acquisition TSA de la crosse au vertex
- 2 autres acquisitions de la base du crâne au vertex
- Durée  $\approx$  22s

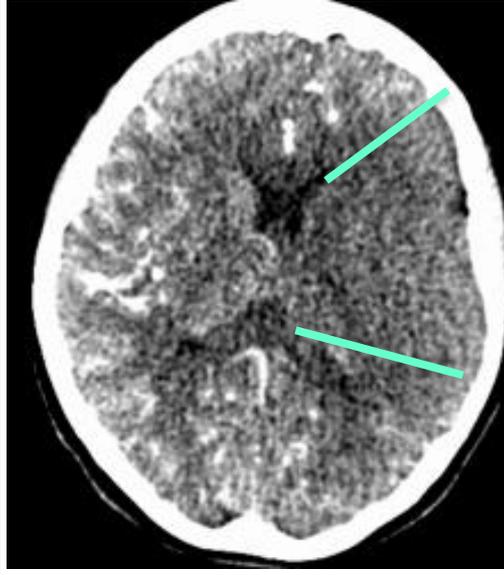
# Scanner multiphasique



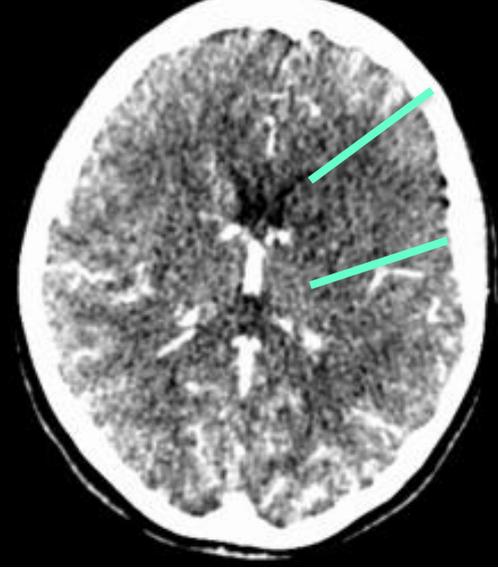
# Scanner multiphasique



Précoce



Intermédiaire



Tardif



Contrôle TDM 72h

**TDM**



**IRM**

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

**AVC du réveil**

# IMAGERIE AVC

## ■ IRM (HAS)

- T2\*
- Diffusion
- FLAIR
- ARM

- Perfusion



**< 10mn**

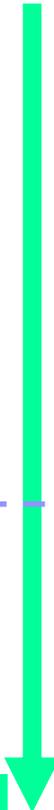
## ■ TDM

- Sans IV
- Angio TSA

- CT multiphases
- Perfusion

6H

24H





# Conclusion



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

