



Ischémie cérébrale aiguë

IRM ... du temps perdu ?

Catherine Oppenheim

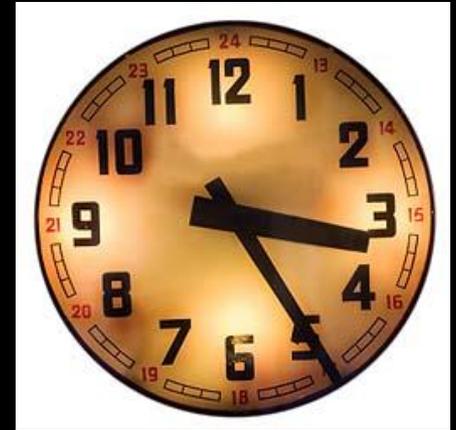
Université Paris Descartes - CH Sainte-Anne

Paris, FRANCE



Stroke Thrombolysis

Save a Minute, Save a Day



- n=2258 (australiens et finnois)
- Thrombolyse IV
- 1 minute gagnée = 1.8 jours vie sans handicap
- 15 min = 1 mois sans handicap ...

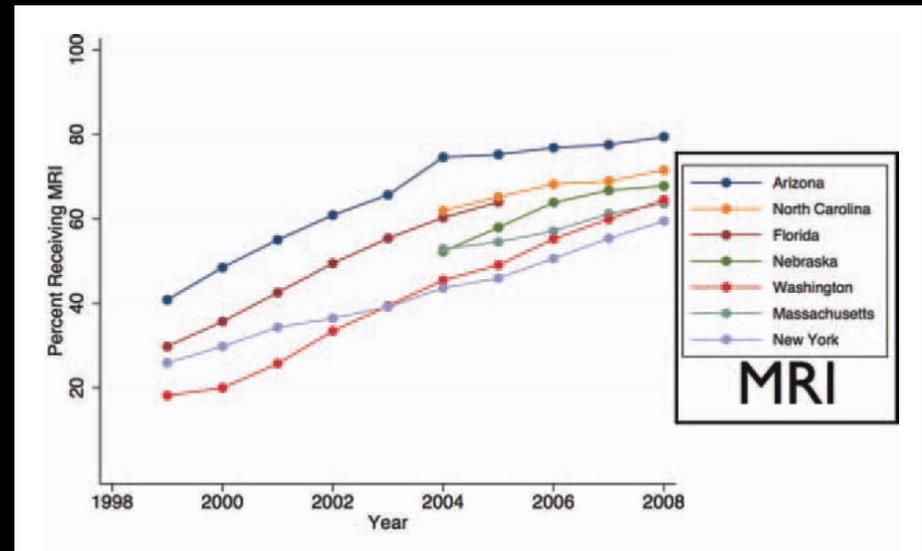
Quelle imagerie pour les AVC ?

Etat des lieux aux USA

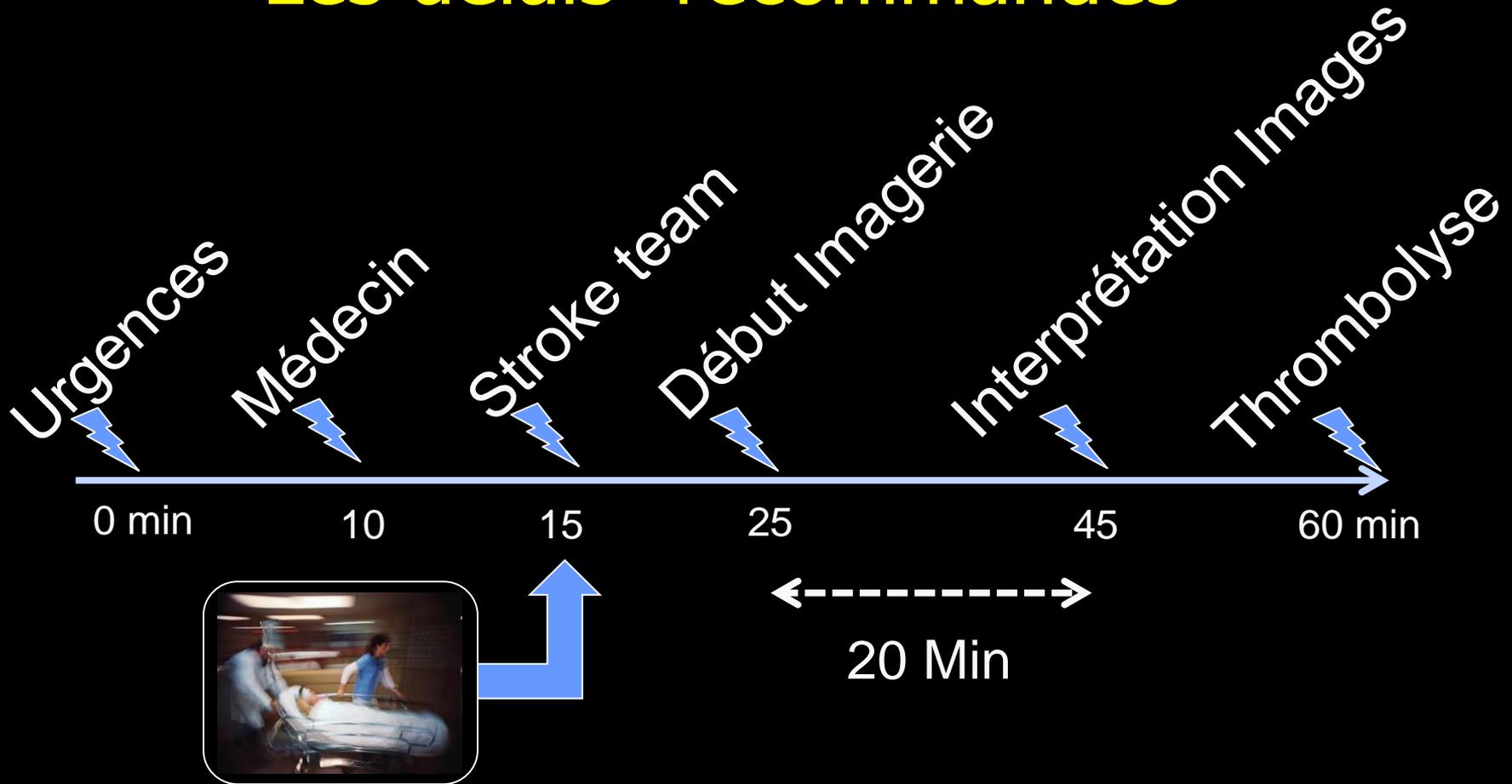
- 624.000 patients
 - 1999 : 28% IRM
 - 2008 : 66% IRM
 - Variations géographiques

- Enquête SFNR 2007 : 1/2 thrombolyse réalisées sur IRM en France

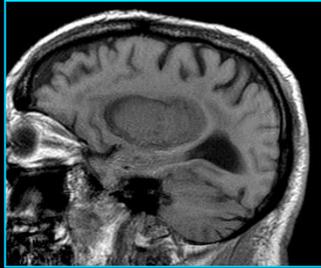
Burke et al. Ann Neurol, 2012; Klein et al. J Neuroradiol 2008



Les délais "recommandés"

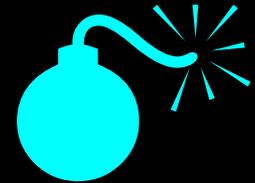
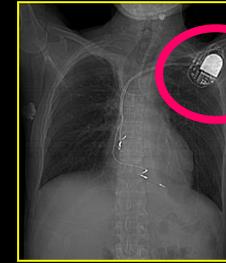


Repérage



Mais

1. Recherche de CI
2. Calibration et Pré-scanning par séquence



INDICATIONS:

Déficit moteur de l'hémicorps droit. Mutisme. Début déficit ce jour à 7h50. IRM débuté à 9h13. Suspicion d'accident ischémique aigu. Score NIHSS avant l'irm = 15. Fin de l'irm à 9h26

TECHNIQUE:

Acquisition de coupes sagittales T1, axiales flair, diffusion, angio-IRM trois D tof du polygone de Willis, séquences axiales T2*, séquence de perfusion.

RÉSULTATS:

Présence d'un hypersignal intra parenchyme sur met en diffusion visible dans la région frontale interne gauche (territoires cérébrale antérieure ainsi que de la région centrale (gyrus pré et post-central gauche) s'étendant plus au cortex insulaire.

Minime hypersignal intra-parenchymateux FLAIR correspondant.

Pas de lésion ischémique controlatérale ou infra-tentorial.

Hypersignaux FLAIR témoignant d'un ralentissement du flux artériel dans le territoire cérébral antérieur et sylvien superficiel gauche. Petit hyposignal T2* d'une branche insulaire gauche ainsi que sur la ligne médiane (thrombus au sein d'une artère cérébrale antérieure).

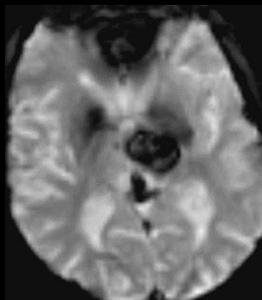
Pas d'anomalie signal des sinus veineux. Pas de stigmat hémorragique intra-parenchymateux.

ARM: aspect d'occlusion environ un centimètre de l'origine de A2 gauche ainsi que d'une branche frontale gauche en distalité de la bifurcation sylvienne. Pas d'occlusion des artères carotides. Dilatation infundibulaire de l'origine de l'artère communicante postérieure gauche. Pas d'anomalie du système vertébro-basilaire.

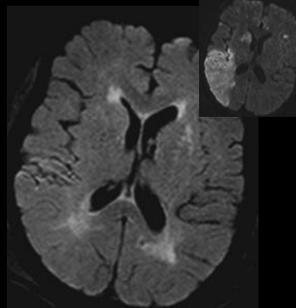
Séquence de perfusion: Aspect d'hypoperfusion dans le territoire de l'artère cérébrale antérieure et le territoire superficiel de l'artère cérébrale moyenne gauche plus étendue que les anomalies de diffusion. En particulier, les zones paraissant hypoperfusées mais encore normale en diffusion sont principalement situés à la

Protocoles ultra-courts

Penser à
l'écho Planar



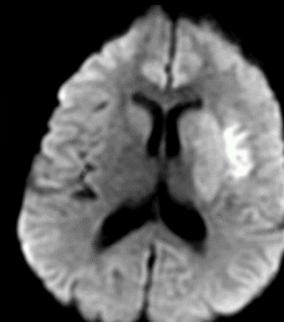
EPI EG



EPI FLAIR¹(51s)

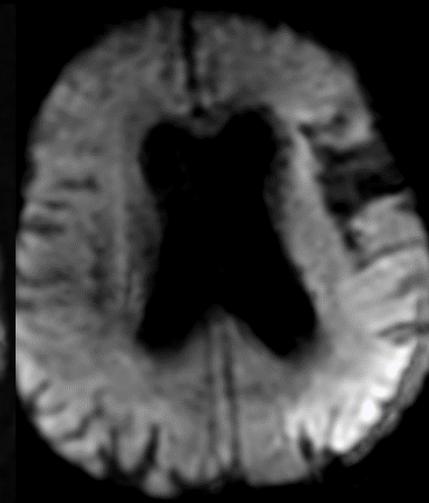
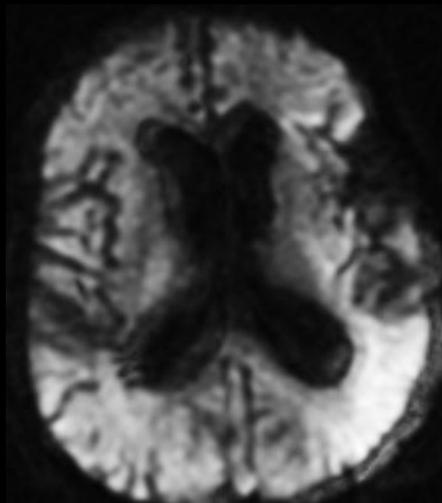
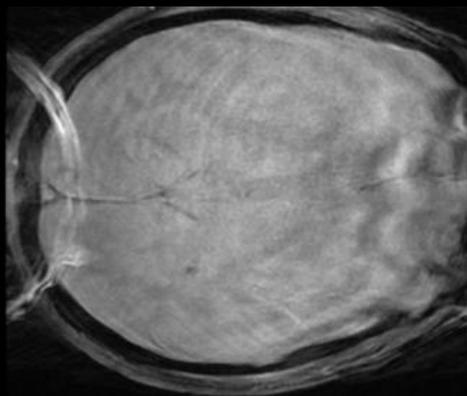


1 min



20 sec, 1 dir

Si patient agité



CH Sainte-Anne : 89% IRM (530 thrombolysees)

1. Meshksar et al. AJNR 2013

IRM et AVC : bénéfique > risque ?

- 1210 patients / 3 groupes :
 - CT < 3h (714) ou IRM < 3h (316)
 - IRM > 3h (180)
- Gpe 0-3h, délai symptôme-traitement
 - TDM vs IRM = 130 vs 135 minutes (médiane) (NS)
 - 0 to 90 minutes : 85 versus 90 minutes
 - 91 to 120 minutes: 110 versus 115 minutes
 - 121 to 180 minutes: 150 versus 152 minutes
- IRM associée à risque plus faible de sICH
 - OR: 0.520 [95% CI: 0.270 to 0.999]

Stroke Mars 2013

JOURNAL OF THE AMERICAN HEART ASSOCIATION



Guidelines for the Early Management of Patients With Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

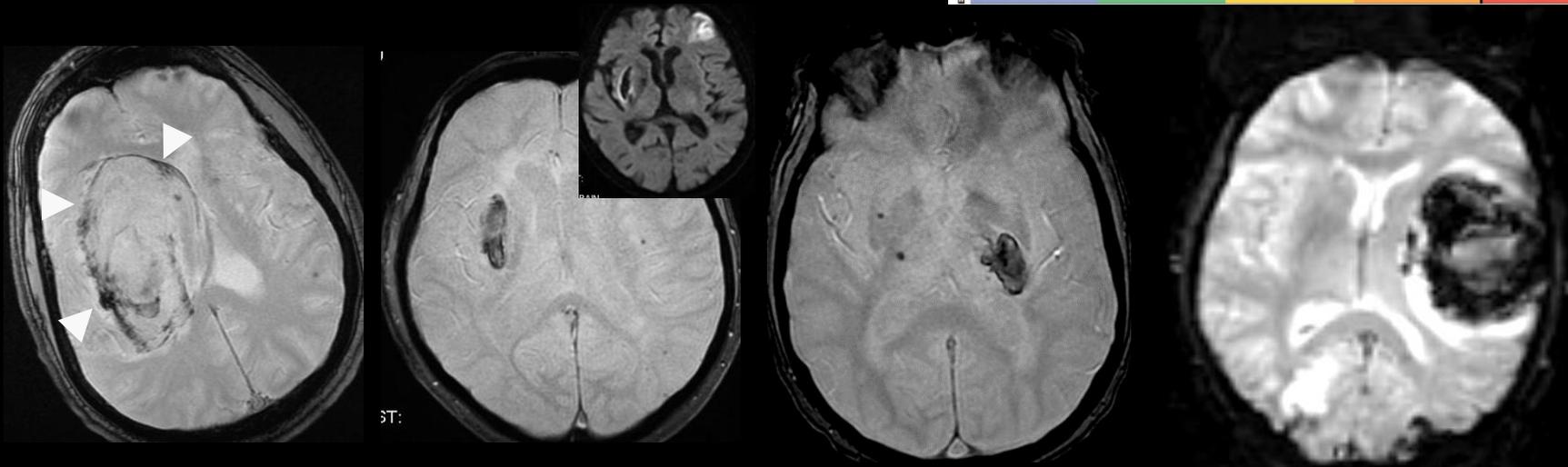
Edward C. Jauch, Jeffrey L. Saver, Harold P. Adams, Jr, Askiel Bruno, J.J. (Buddy) Connors, Bart M. Demaerschalk, Pooja Khatri, Paul W. McMullan, Jr, Adnan I. Qureshi, Kenneth Rosenfield, Phillip A. Scott, Debbie R. Summers, David Z. Wang, Max Wintermark and Howard Yonas

		SIZE OF TREATMENT EFFECT												
		CLASS I <i>Benefit >>> Risk</i> Procedure/Treatment SHOULD be performed/administered	CLASS IIa <i>Benefit >> Risk</i> Additional studies with <i>focused objectives</i> needed IT IS REASONABLE to perform procedure/administer treatment	CLASS IIb <i>Benefit ≥ Risk</i> Additional studies with <i>broad objectives</i> needed; additional <i>registry data</i> would be helpful Procedure/Treatment MAY BE CONSIDERED	CLASS III <i>No Benefit or CLASS III Harm</i> <table border="1"> <thead> <tr> <th></th> <th>Procedure/ Test</th> <th>Treatment</th> </tr> </thead> <tbody> <tr> <td>COR III: No benefit</td> <td>Not Helpful</td> <td>No Proven Benefit</td> </tr> <tr> <td>COR III: Harm</td> <td>Excess Cost w/o Benefit or Harmful</td> <td>Harmful to Patients</td> </tr> </tbody> </table>		Procedure/ Test	Treatment	COR III: No benefit	Not Helpful	No Proven Benefit	COR III: Harm	Excess Cost w/o Benefit or Harmful	Harmful to Patients
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● Scanner ou IRM avant thrombolyse :

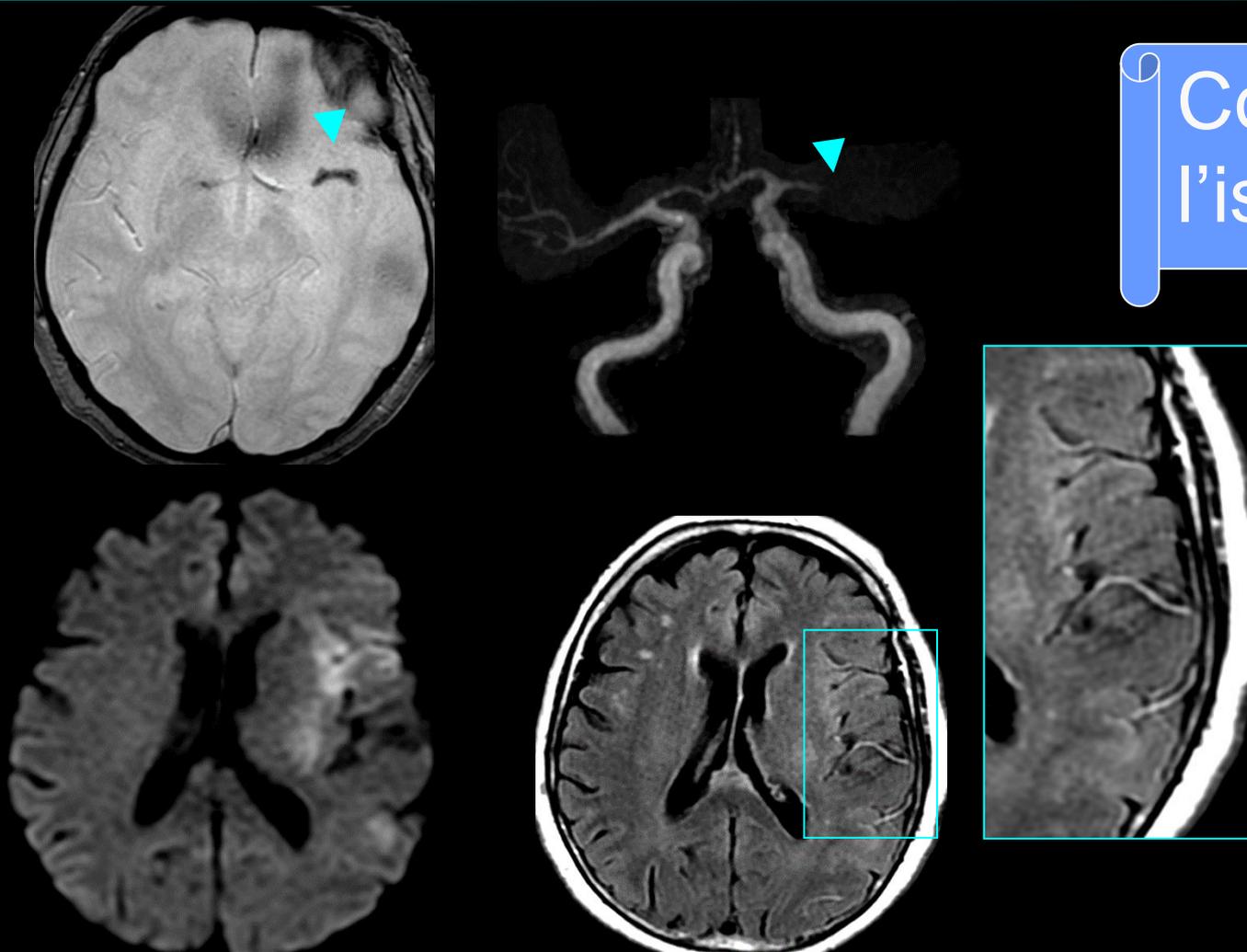
- Eliminer un saignement
- Confirmer l'ischémie

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT	SIZE OF TREATMENT EFFECT			
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Kidwell et al. JAMA. 2004 Fiebach et al. Stroke 2004
 Silvera et al. AJNR 2005 Oppenheim et al. Cerebrovasc Dis. 2005;
 Brazelli et al. BMJ, 2009 . Copenhaver Neurology 2009

Confirmer
l'ischémie

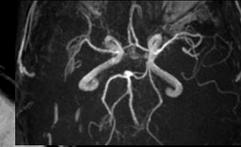
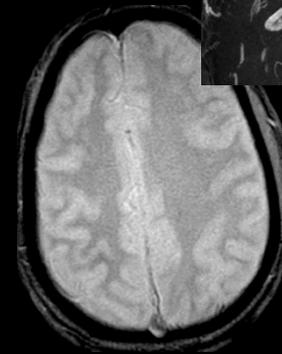
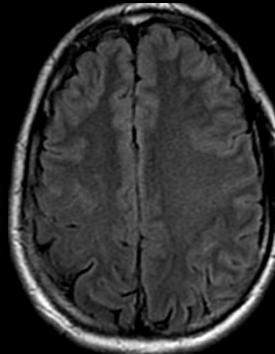
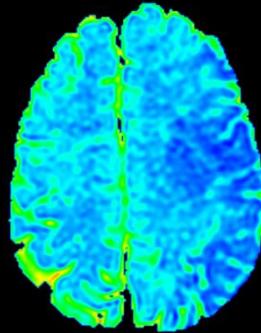
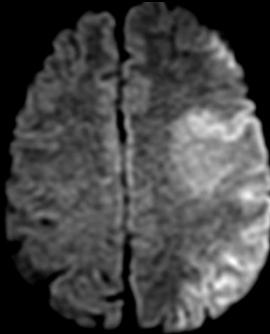


- Ischémie < 12h : [1, 2]
 - sensibilité 0.99 (95% CI 0.23 to 1.00)
 - spécificité 0.92 (95% CI 0.83 to 0.97)
- Excellente reproductibilité inter-observateur

1. Brazelli et al. BMJ 2009
2. Schellinger et al. Neurology 2010

Confirmer l'ischémie ?

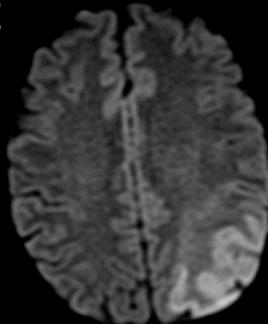
Cas 1



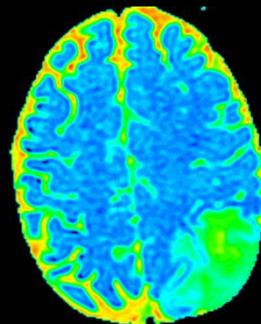
Ischémie

Cas 2

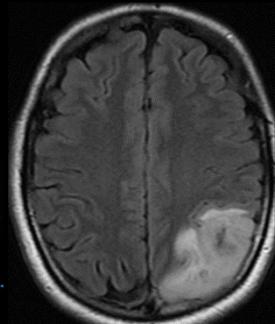
Diffusion



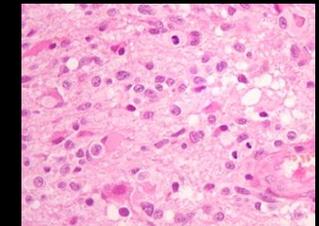
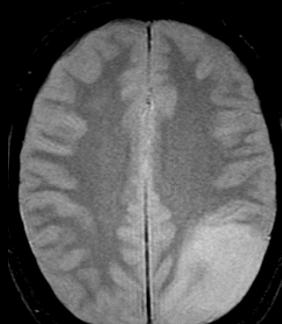
ADC



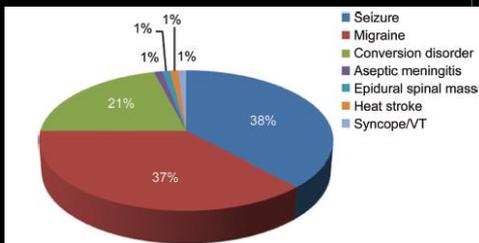
FLAIR



T2*

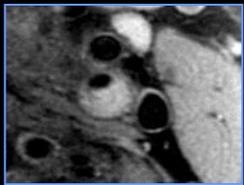
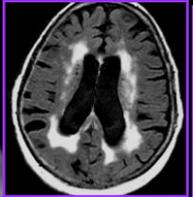
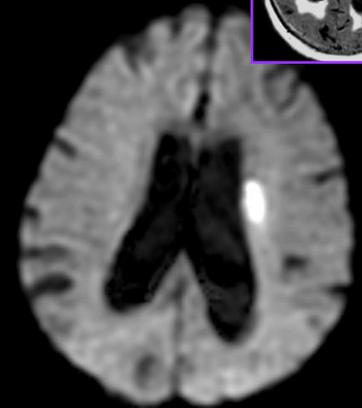
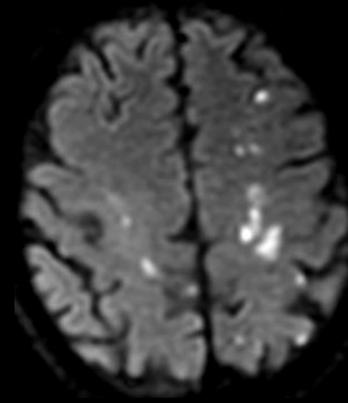
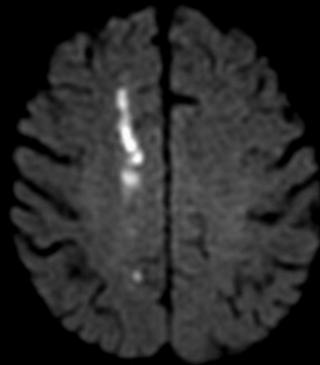
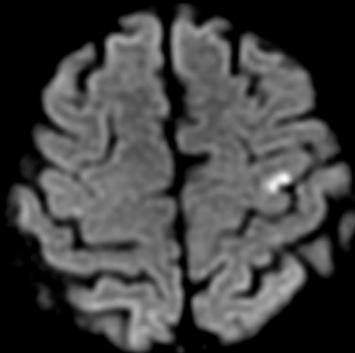


Tumeur gliale

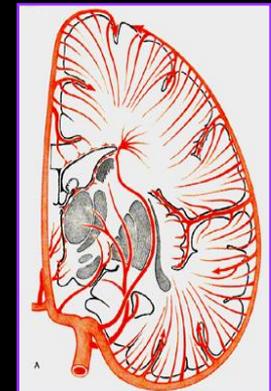
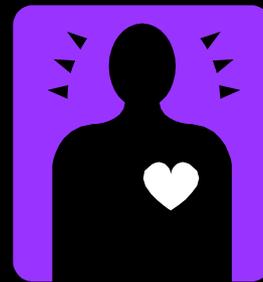
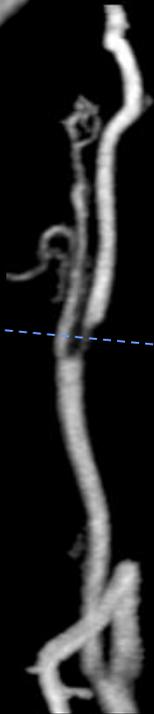


- 512 patients thrombolysés sur TDM
- 14% stroke mimics !

Etiologie



Plaque
d'athérome
hémorragique



Braemswig et al.
Stroke 2013

● Imagerie de perfusion – Si > 4.5h

CT perfusion and MRI perfusion and diffusion imaging, including measures of infarct core and penumbra, may be considered for the selection of patients for acute reperfusion therapy beyond the time windows for intravenous fibrinolysis. These techniques provide additional information that may improve diagnosis, mechanism, and severity of ischemic stroke and allow more informed clinical decision making (Class IIb; Level of Evidence B). (Revised from the 2009 imaging scientific statement⁹)

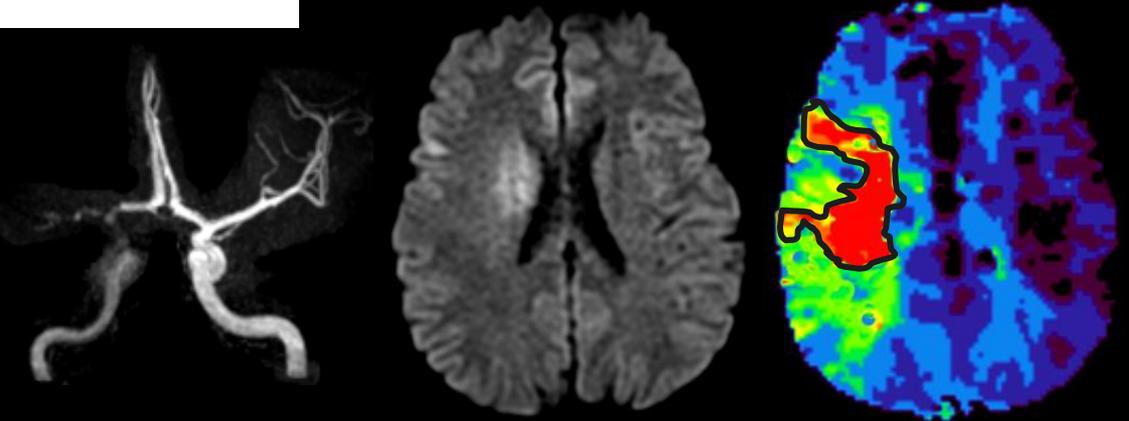
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TARGET MISMATCH (DEFUSE 2)

$$\frac{\text{Vol PWI (Tmax > 6s)}}{\text{Vol DWI}} \geq 1,8$$

and DWI < 70 mL

and PWI (Tmax > 10s) < 100 mL

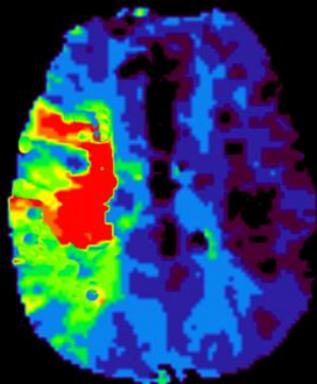
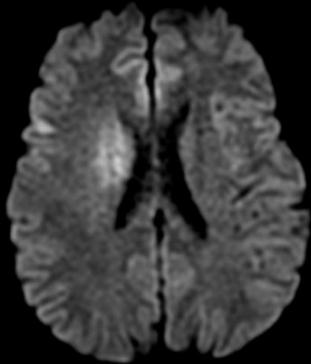


Vol PWI/DWI=3

Tmax > 6s

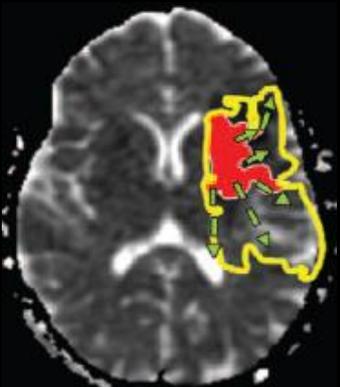
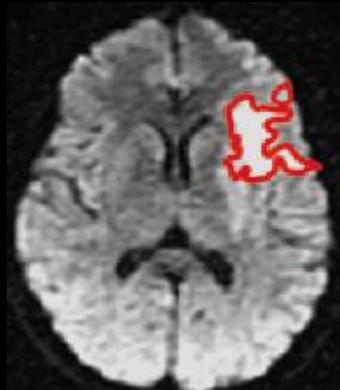
Imagerie de la pénombre ischémique...

Perfusion/DWI



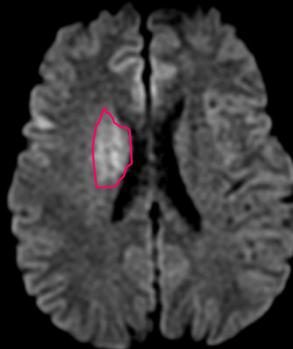
Tmax

ADC / DWI



Rosso et al.
Radiology 2009-12

ARM / DWI



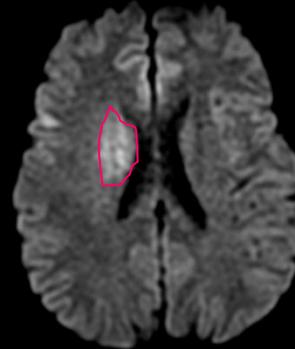
Vol < 15 cc



Occlusion
proximale

Lansberg
Stroke 2008

Clinical/ DWI

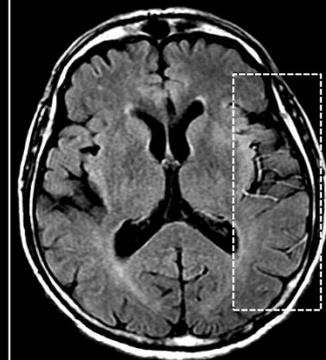
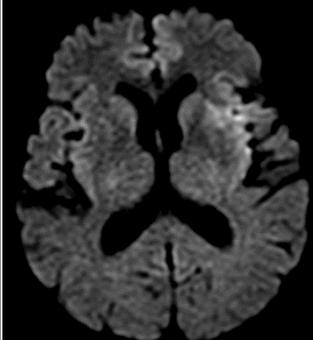


Vol < 25 cc

NIHSS > 8

Davalos.
Neurology 2004

FVH/ DWI



Legrand et al.
Stroke submitted

- **Interprétation des images**

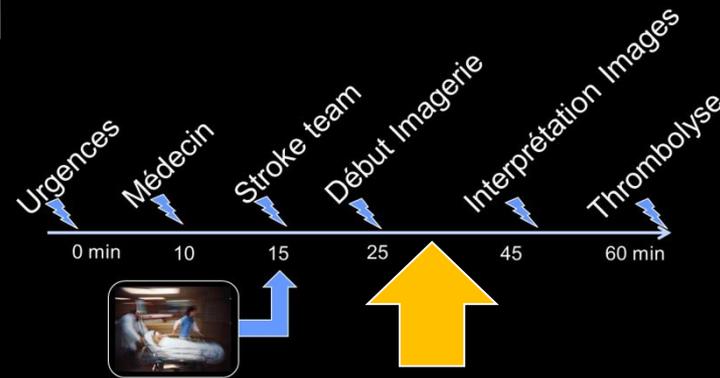
- Début examen-
interprétation <20 min
- **Télé-transmission**

- **Formation +++**

- **Logiciel calcul automatique**

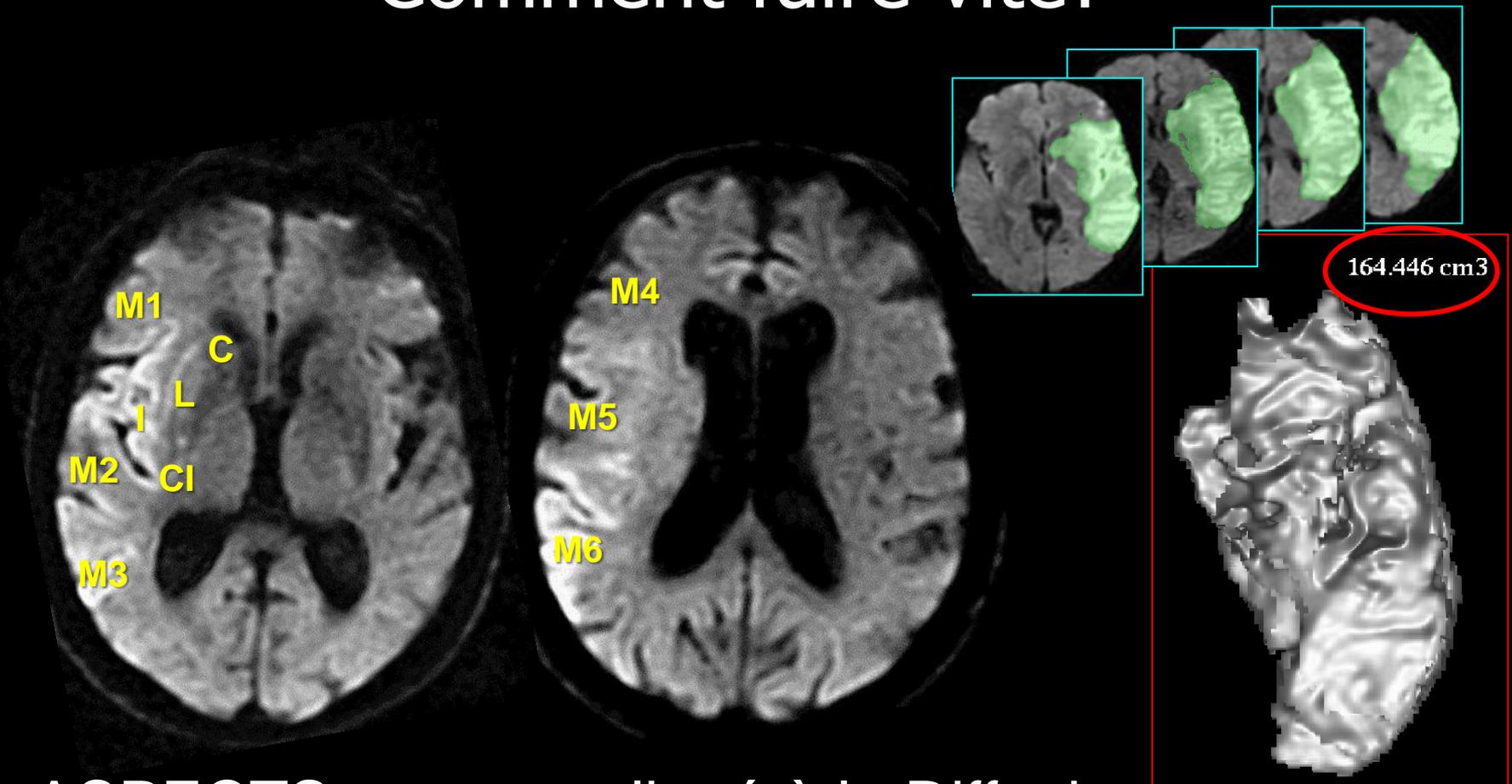
- Volume diffusion
- Volume hypoperfusion
- Mismatch

In intravenous fibrinolysis candidates, the brain imaging study should be interpreted within 45 minutes of patient arrival in the ED by a physician with expertise in reading CT and MRI studies of the brain parenchyma (*Class I; Level of Evidence C*). (Revised from the previous guideline¹³)



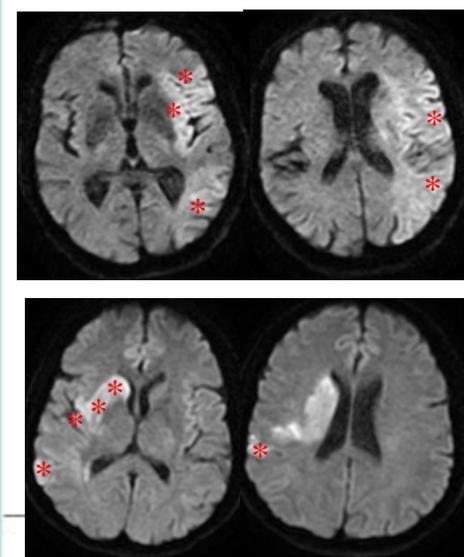
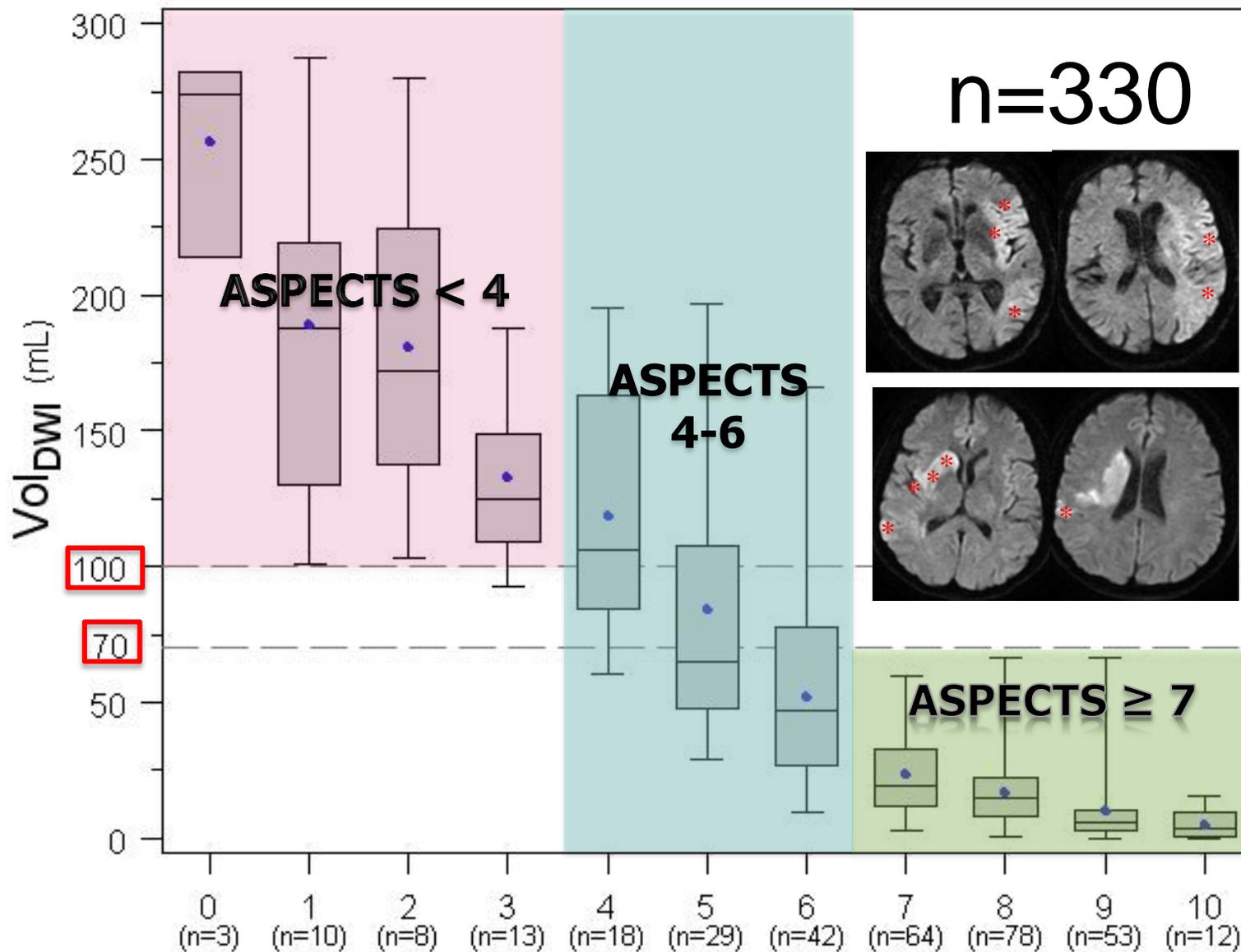
		SIZE OF TREATMENT EFFECT			
		CLASS I Benefit >>> Risk Procedure/Treatment SHOULD be performed/administered	CLASS IIa Benefit >> Risk Additional studies with focused objectives needed IT IS REASONABLE to perform procedure/administer treatment	CLASS IIb Benefit ≥ Risk Additional studies with broad objectives needed; additional registry data would be helpful Procedure/Treatment MAY BE CONSIDERED	CLASS III No Benefit or CLASS III Harm Procedure/Treatment COR III: No benefit, No Proven Benefit COR III: Harm, Excess Cost, Harmful to Patients or Harmful
ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT	LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	<ul style="list-style-type: none"> Recommendation that procedure or treatment is useful/effective Sufficient evidence from multiple randomized trials or meta-analyses 	<ul style="list-style-type: none"> Recommendation in favor of treatment or procedure being useful/effective Some conflicting evidence from multiple randomized trials or meta-analyses 	<ul style="list-style-type: none"> Recommendation's usefulness/efficacy less well established Greater conflicting evidence from multiple randomized trials or meta-analyses 	<ul style="list-style-type: none"> Recommendation that procedure or treatment is not useful/effective and may be harmful Sufficient evidence from multiple randomized trials or meta-analyses
	LEVEL B Limited populations evaluated* Data derived from a single randomized trial or nonrandomized studies	<ul style="list-style-type: none"> Recommendation that procedure or treatment is useful/effective Evidence from single randomized trial or nonrandomized studies 	<ul style="list-style-type: none"> Recommendation in favor of treatment or procedure being useful/effective Some conflicting evidence from single randomized trial or nonrandomized studies 	<ul style="list-style-type: none"> Recommendation's usefulness/efficacy less well established Greater conflicting evidence from single randomized trial or nonrandomized studies 	<ul style="list-style-type: none"> Recommendation that procedure or treatment is not useful/effective and may be harmful Evidence from single randomized trial or nonrandomized studies
	LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care	<ul style="list-style-type: none"> Recommendation that procedure or treatment is useful/effective Only expert opinion, case studies, or standard of care 	<ul style="list-style-type: none"> Recommendation in favor of treatment or procedure being useful/effective Only diverging expert opinion, case studies, or standard of care 	<ul style="list-style-type: none"> Recommendation's usefulness/efficacy less well established Only diverging expert opinion, case studies, or standard of care 	<ul style="list-style-type: none"> Recommendation that procedure or treatment is not useful/effective and may be harmful Only expert opinion, case studies, or standard of care

Etendue de l'infarctus en diffusion Comment faire vite?



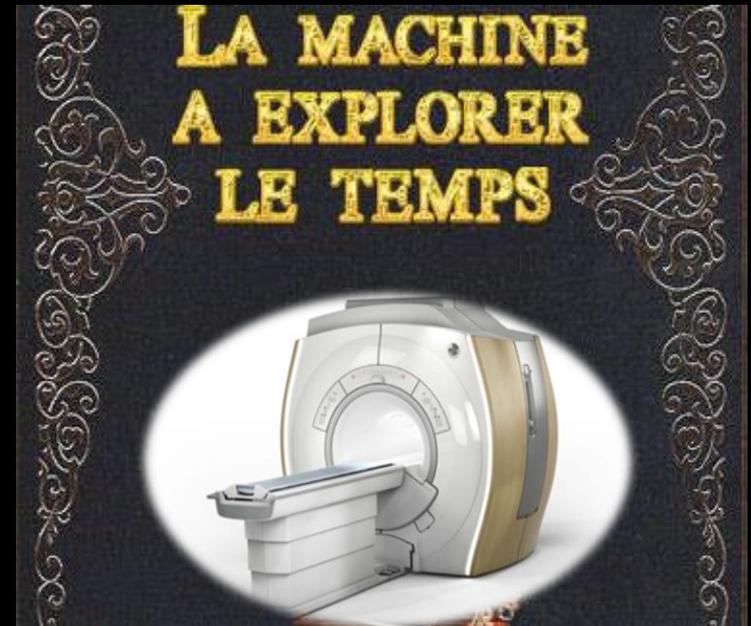
ASPECTS score appliqué à la Diffusion
10 régions = 10 points. Ici, ASPECTS=10-6=4

n=330



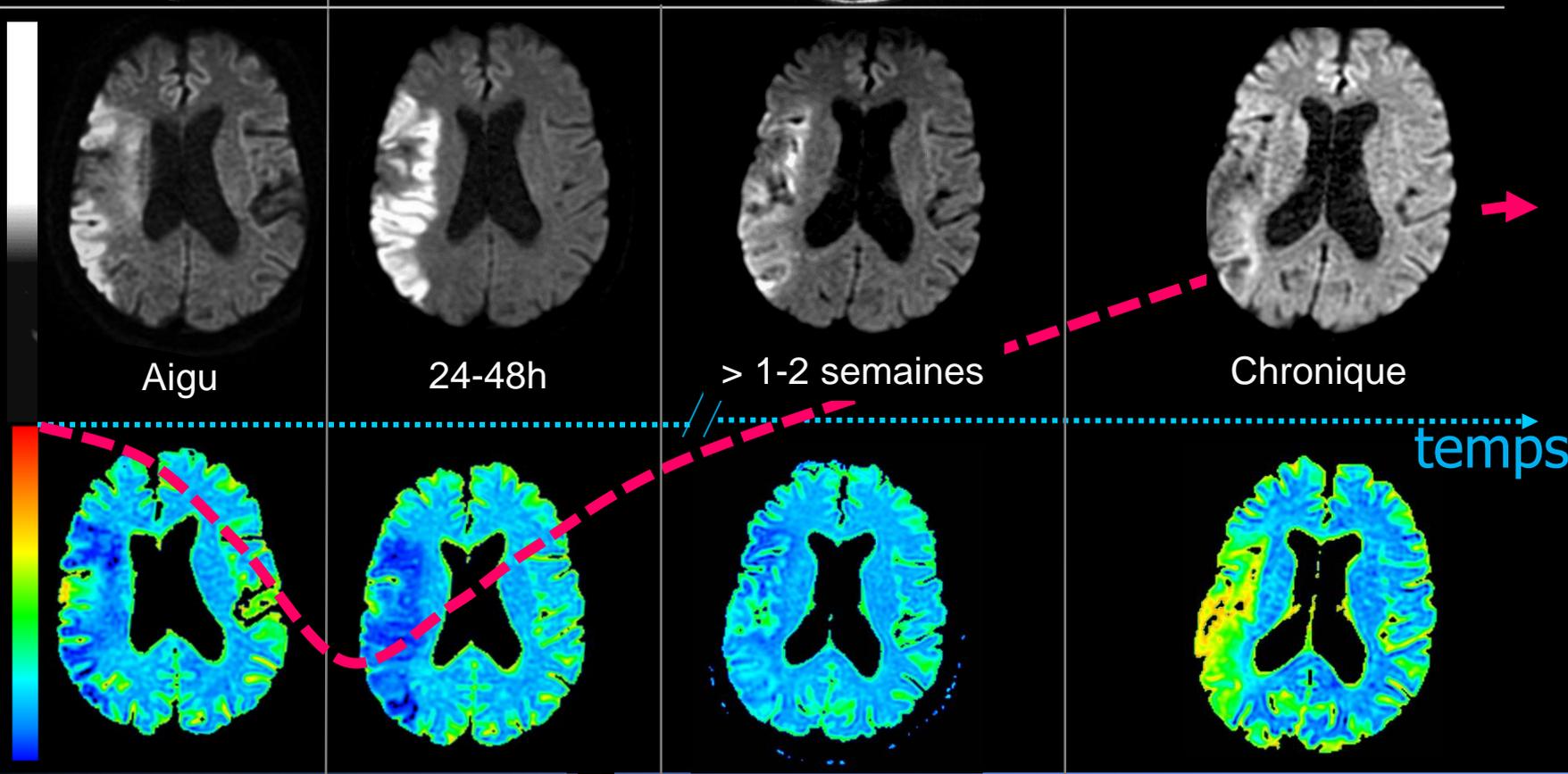
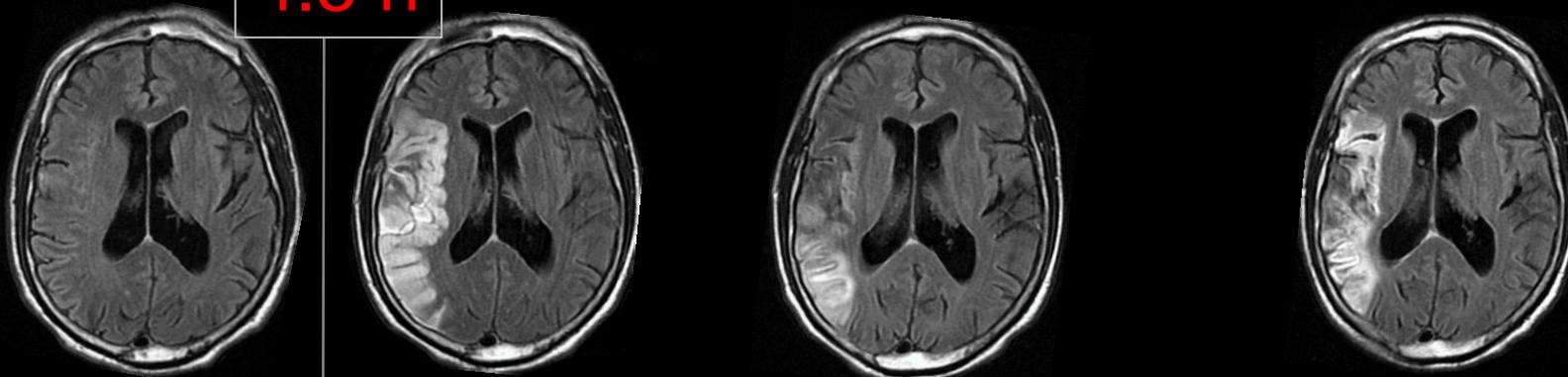
AVC : heure de début inconnue

- 16-28% AVC [1,2,5]
- Certains pourraient bénéficier d'une thrombolyse [4]
- Bcp ont un mismatch FLAIR-Diffusion [6, 7]

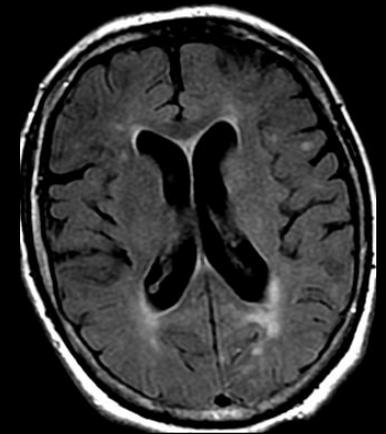
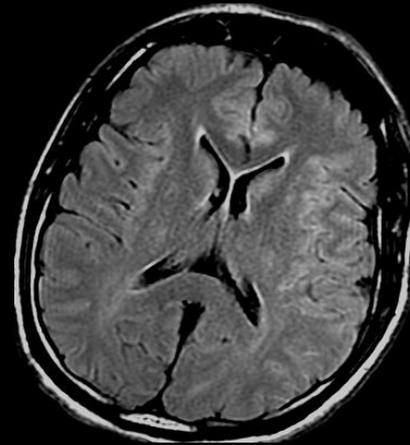
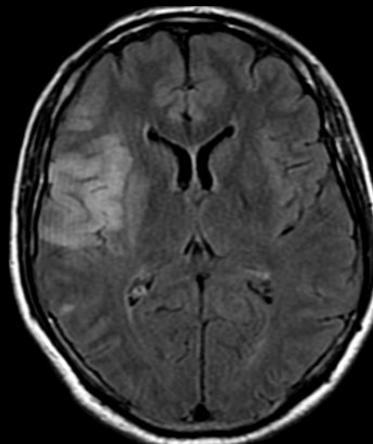
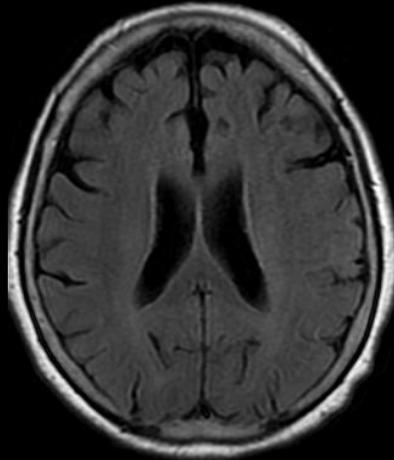
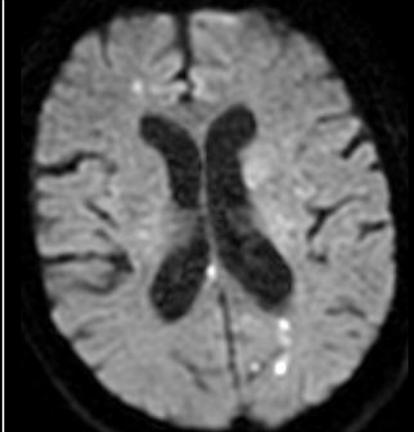
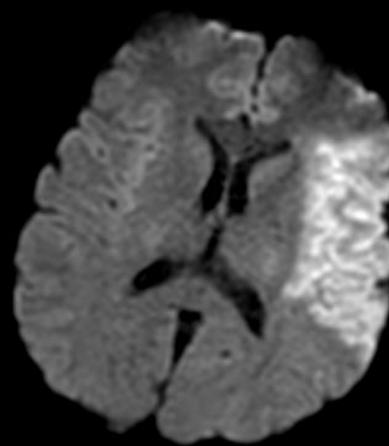
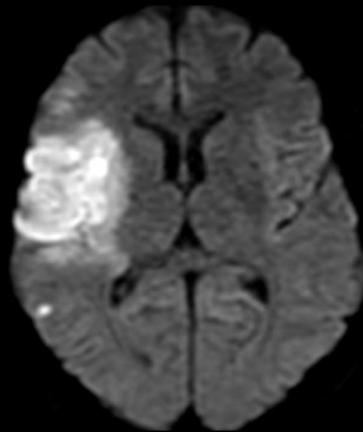
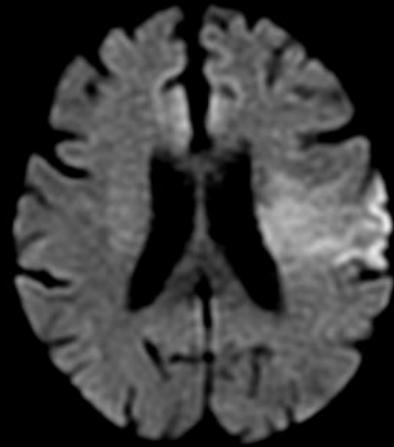


1. Fink, Stroke 2002
2. Serena, CVD 2003
3. Todo CVD 2006
4. Barreto Stroke 2009;
5. Mackey et al.
6. Neurology 2011. Huisa et al. J Stroke Cereb Vasc Dis 2013
- 7 Kim Stroke 214

4.5 h



FLAIR vs Diffusion



FLAIR-

FLAIR+

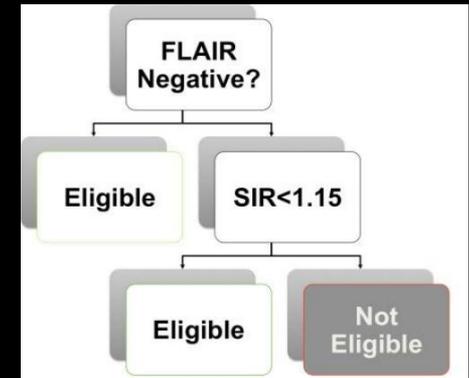
FLAIR « subtile »

Leucoaraiose

Ebinger et al. 2009; Thomalla et al. Ann Neurol 2009 ; Aoki et al. J Neurol Science 2010 ; Petkova et al. Radiology 2010; Emeriau et al. Stroke 2013

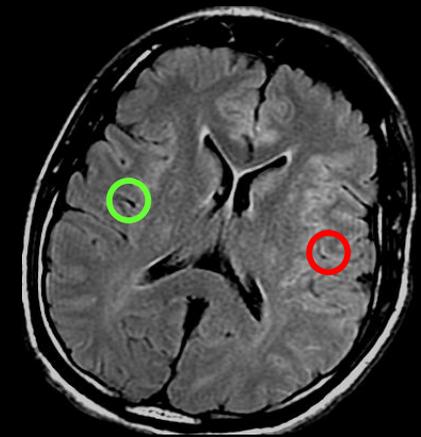
Mismatch FLAIR / Diffusion

Quoi de neuf ?



MR WITNESS trial
(2011-dec 2015)

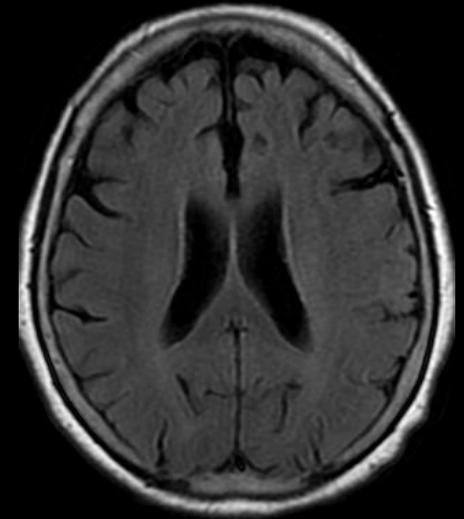
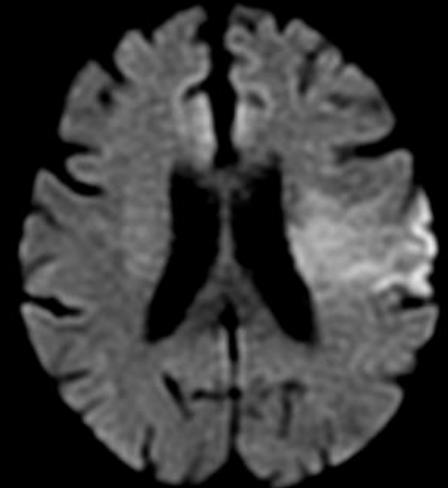
- Pre-FLAIR study (n=543) [1]
 - AVC < 4.5h : Spécificité 78%, VPP=83%
 - Reproductibilité inter-obs K=0.6 !
- Les ratios pourraient être utiles [4]
- Moins performant pour AVC VB [2]
- Validé à 3T [3]



rSI < 1.2

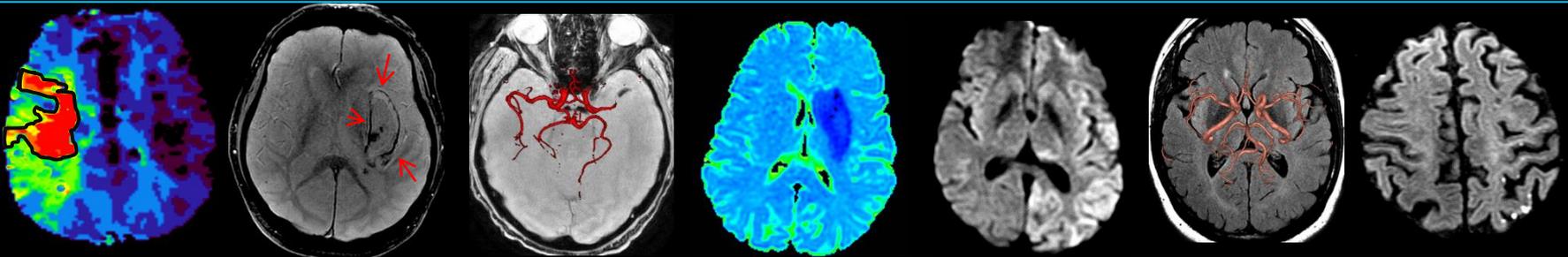
1. Thomalla G. Lancet Neurol 2011. 2. Grosse-Dreselhaus et al. PLOS 2014;
3. Emeriau et al. Stroke 2013. Song et al. Stroke 2012

- Déjà intégré dans la pratique de certains centres !
- MR Witness [2]
- Wake-up stroke study [1]
 - 800 patients prévus
 - Placebo vs rt-PA chez patients avec FLAIR normal...



Conclusion : IRM

- Quelques minutes de plus par rapport au TDM
- Conforme aux recommandations
- Evite de thrombolyser 14% stroke mimics
- AVC d'heure de début inconnue +++



2014

Stroke Thrombolysis
Save a Minute, Save a Day



Et bientôt peut être ...

MR-based Thrombolysis
Scan for a minute, Save a Day ?