IRM multimodale après agression cérébrale

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CCA Réanimation chirurgicale polyvalente Husson Mourier
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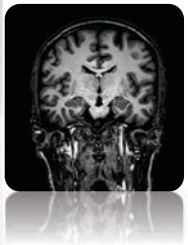
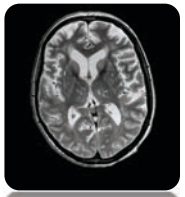
IRM morphologique

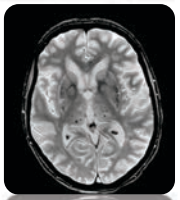
3D-T1
IR-FSPGR (GE)
MPR (Siemens / Philips)



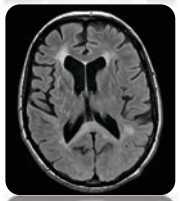
T2 (2mm)



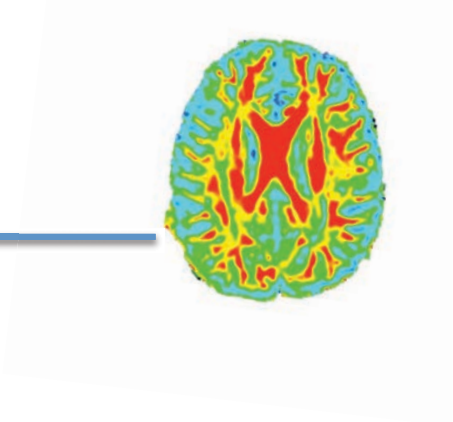
T2* or SWI



T2 FLAIR (3 mm)



IRM multimodale



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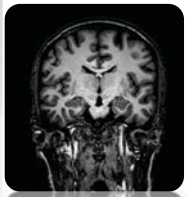
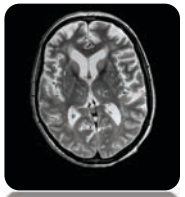
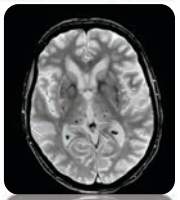
MPR (Siemens / Philips)



T2 (2mm)



T2* or SWI



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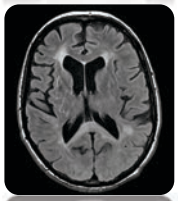
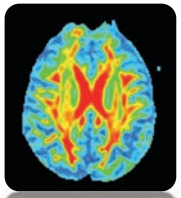
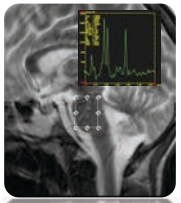


DTI

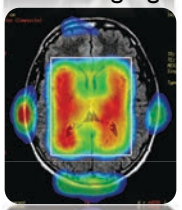


MRS

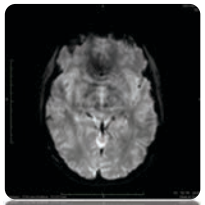
SVS pons



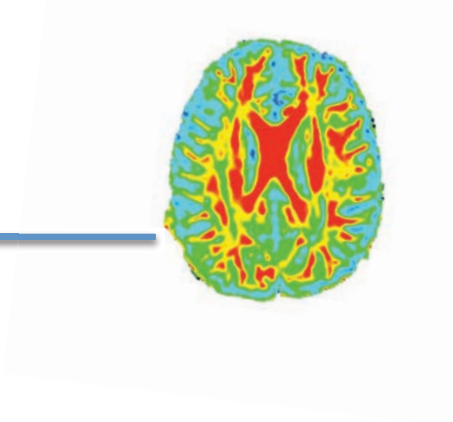
CSI basal ganglia



fMRI rs
(optional)

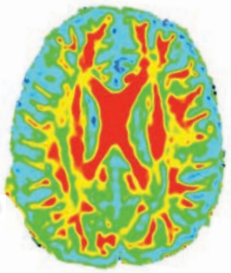


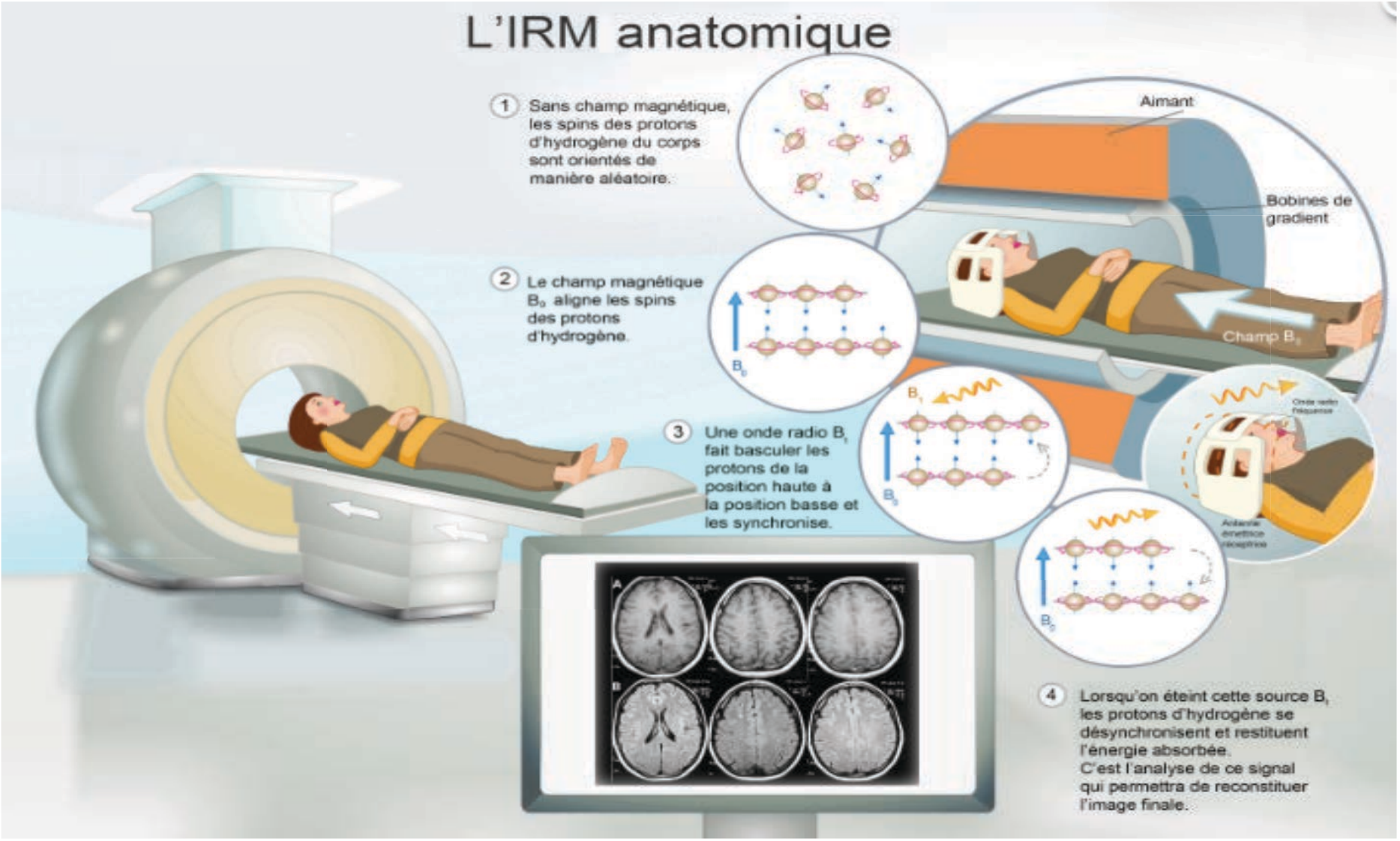
Plan



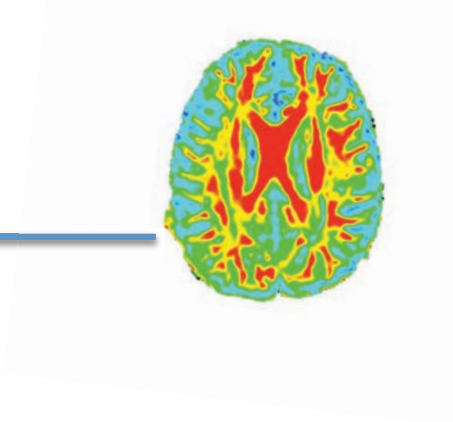
- IRM morphologique rappels
- IRM en tenseur de diffusion
- Spectro-IRM
- IRM fonctionnelle-RS-BOLD
- Applications

IRM morphologique





Plan



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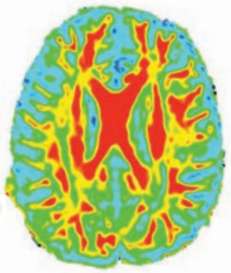
DWI

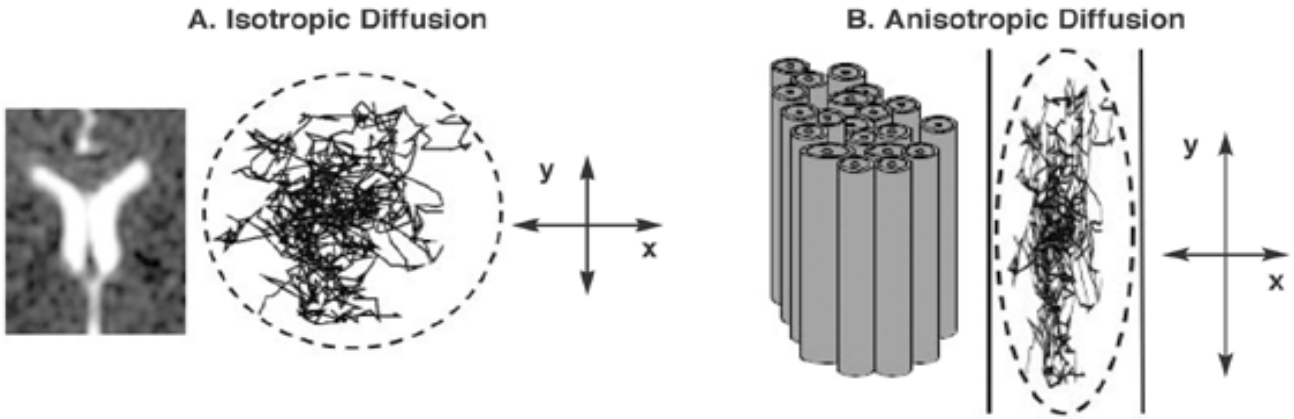


- Quand on parle de diffusion, on parle des molécules d'eau
- Mouvements Browniens ou libres (LCR)

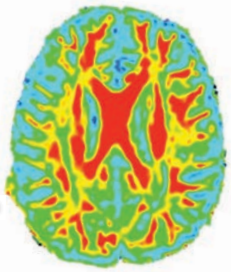
➢ Diffusion isotrope

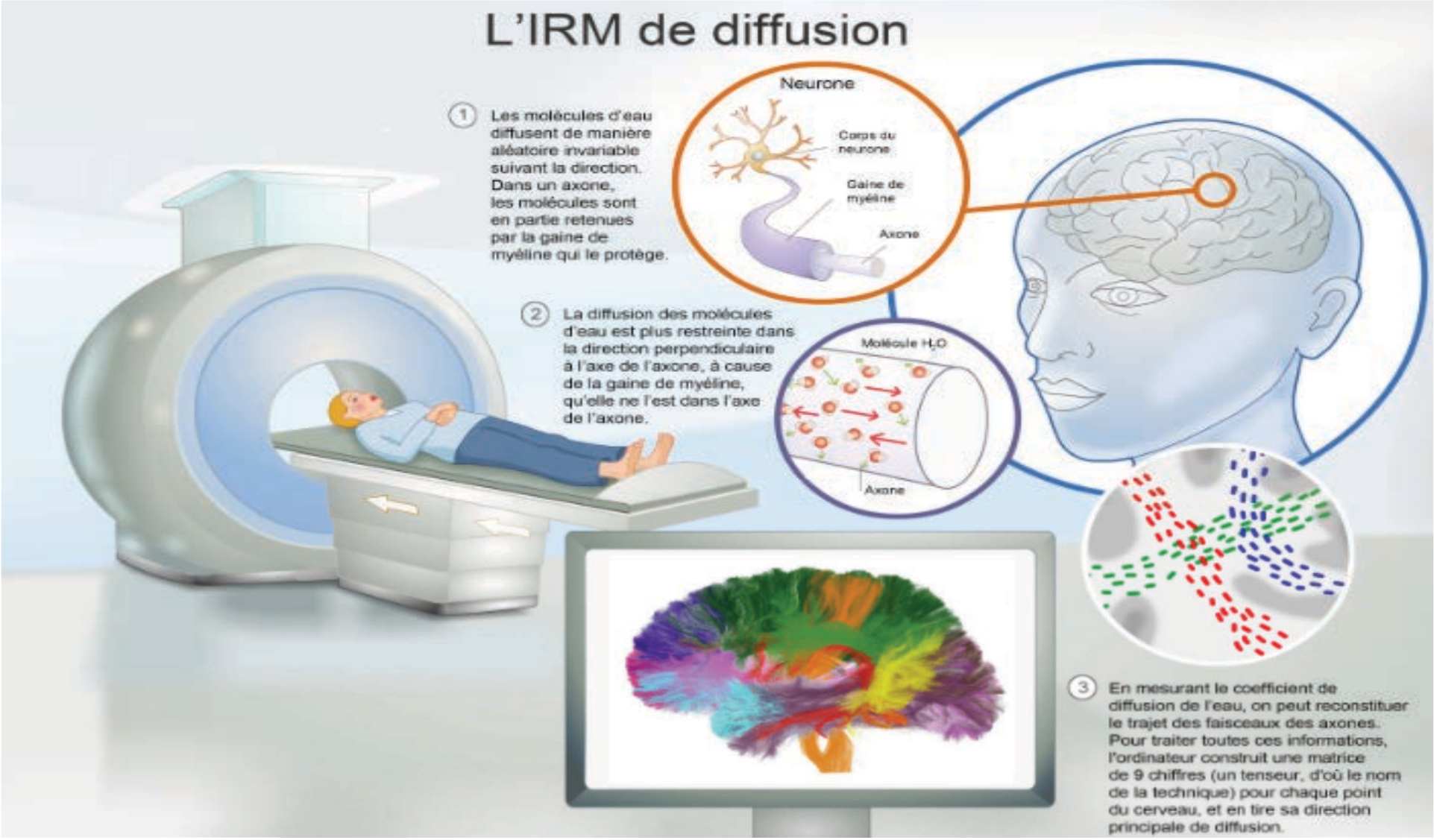
- Ou restreints/contraints (axones)

➢ Diffusion anisotrope

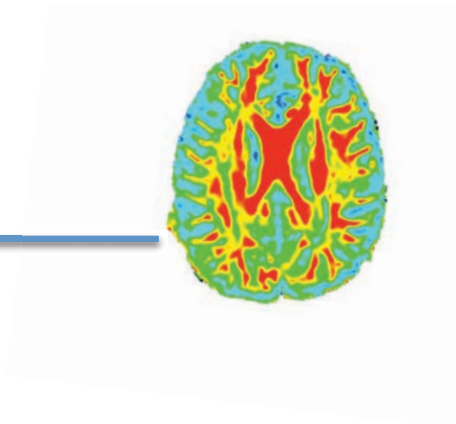


DWI

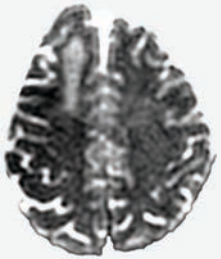



L'IRM de diffusion
1 Les molécules d'eau diffusent de manière aléatoire invariable suivant la direction. Dans un axone, les molécules sont en partie retenues par la gaine de myéline qui le protège.
Neurone
Corps du neurone
Gaine de myéline
Axone
2 La diffusion des molécules d'eau est plus restreinte dans la direction perpendiculaire à l'axe de l'axone, à cause de la gaine de myéline, qu'elle ne l'est dans l'axe de l'axone.
Molécule H_2O
Axone
3 En mesurant le coefficient de diffusion de l'eau, on peut reconstituer le trajet des faisceaux des axones. Pour traiter toutes ces informations, l'ordinateur construit une matrice de 9 chiffres (un tenseur, d'où le nom de la technique) pour chaque point du cerveau, et en tire sa direction principale de diffusion.

DWI

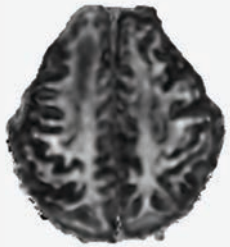


Mean Diffusivity (MD)
= ADC



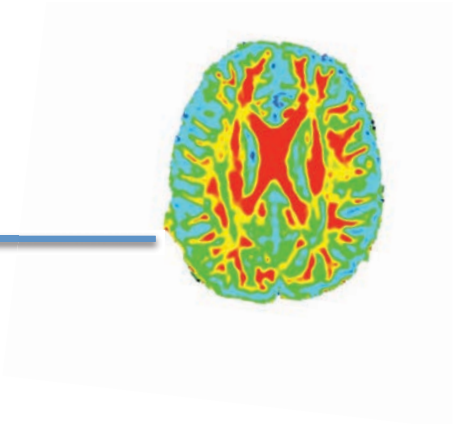
$$MD = \bar{\lambda} = \frac{\lambda_1 + \lambda_2 + \lambda_3}{3}$$

Fractionnal Anisotropy (FA)



$$FA = \sqrt{\frac{2}{3}} \cdot \sqrt{\frac{(\lambda_1 - \bar{\lambda})^2 + (\lambda_2 - \bar{\lambda})^2 + (\lambda_3 - \bar{\lambda})^2}{\lambda_1^2 + \lambda_2^2 + \lambda_3^2}}$$

DWI



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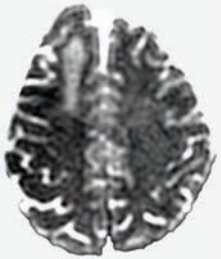

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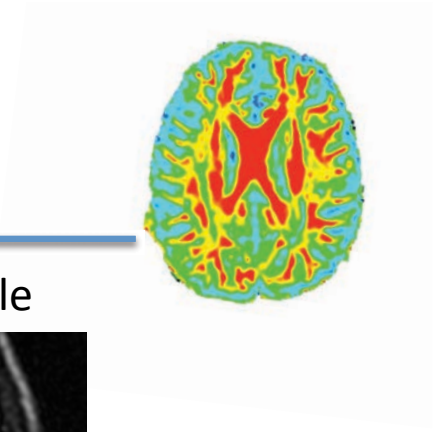

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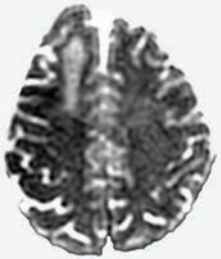

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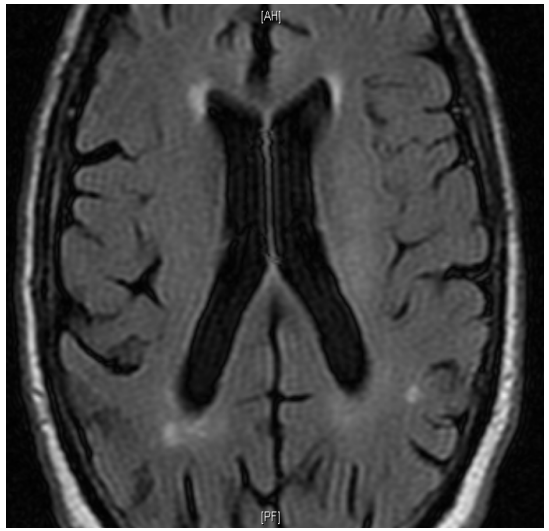
Hémiplégie droite brutale



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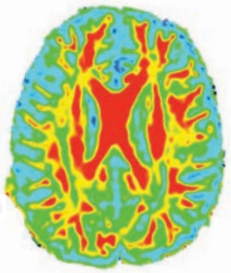

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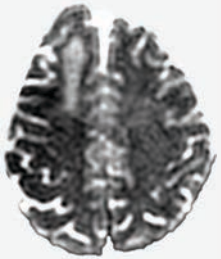

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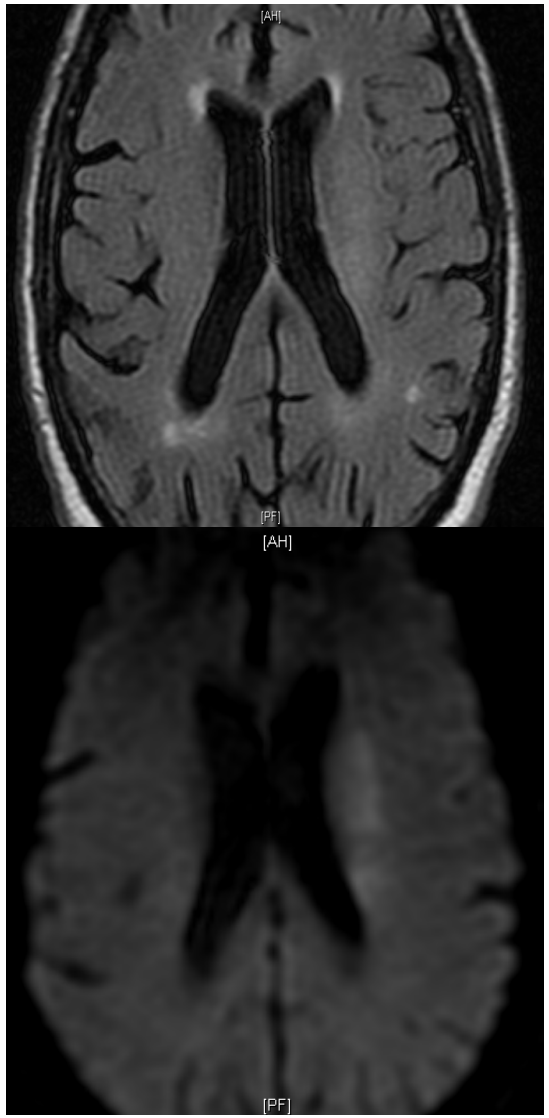

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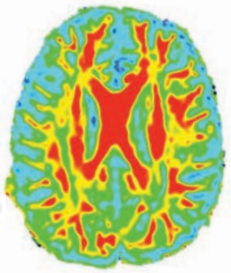

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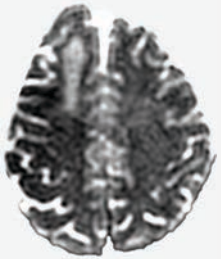

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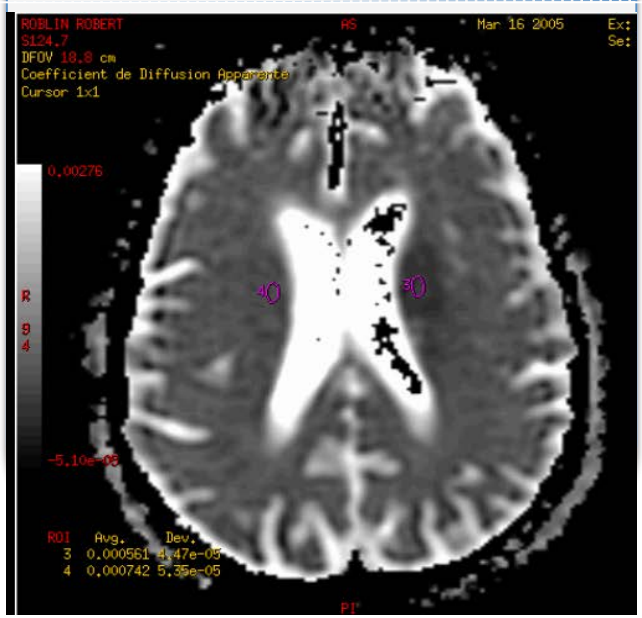
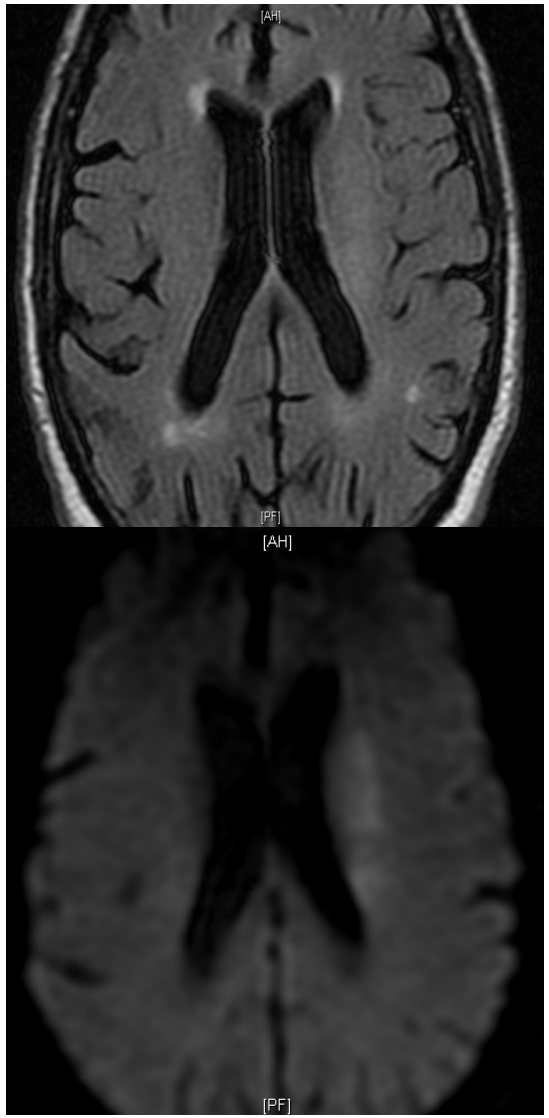


Hémiplégie droite brutale



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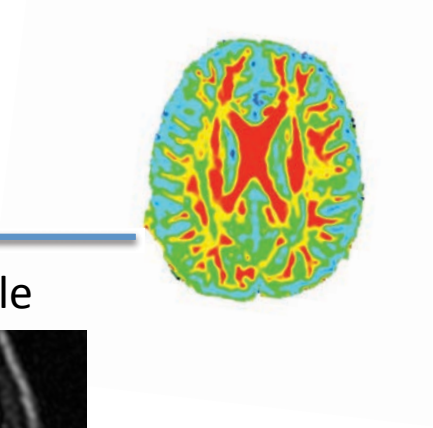

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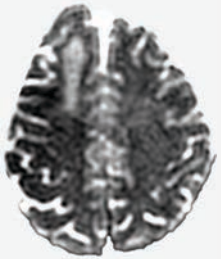

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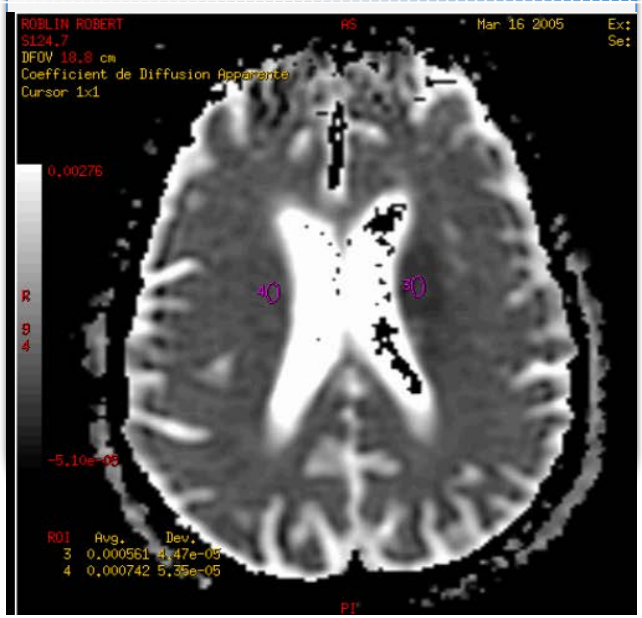

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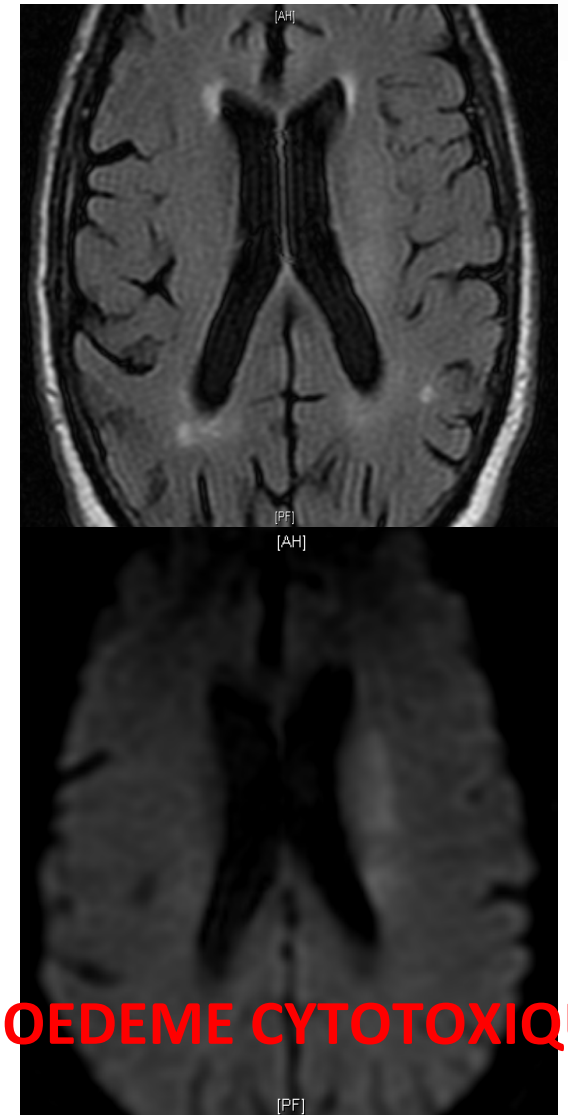
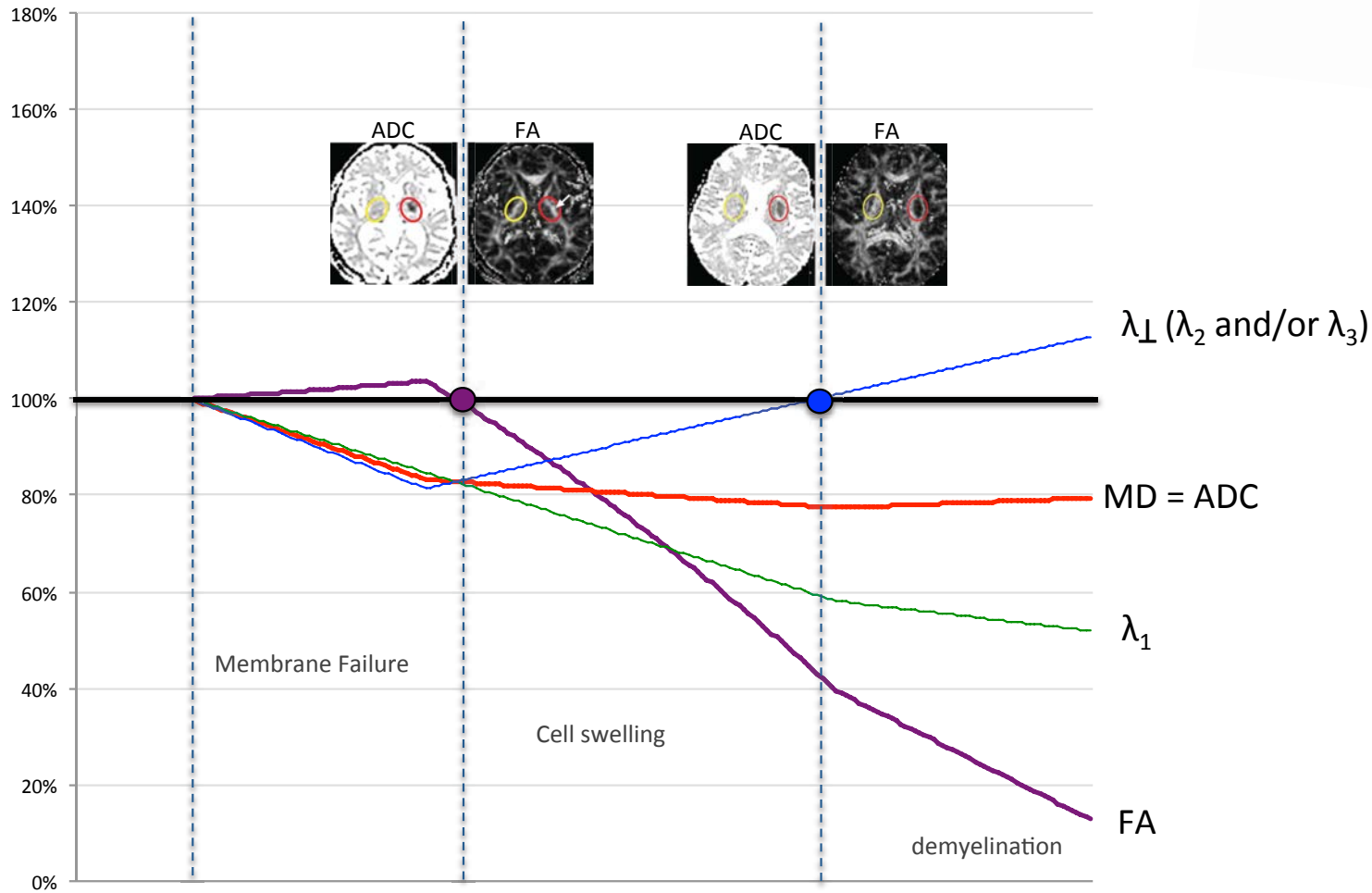


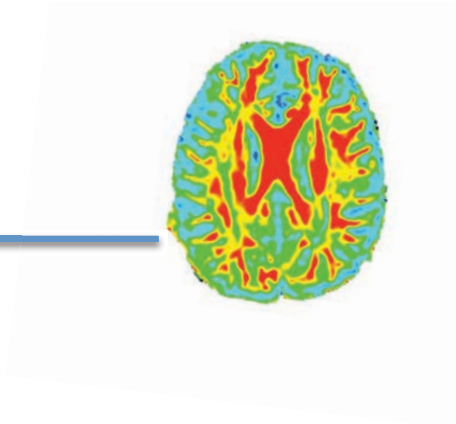
OEDEME CYTOTOXIQUE

DWI & œdème cytotoxique



Courtesy from Lionel Velly

DWI



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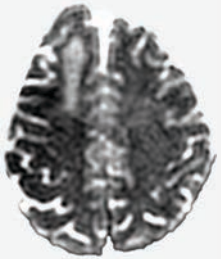

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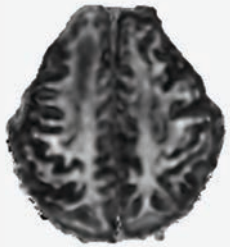
Fractionnal Anisotropy (FA)



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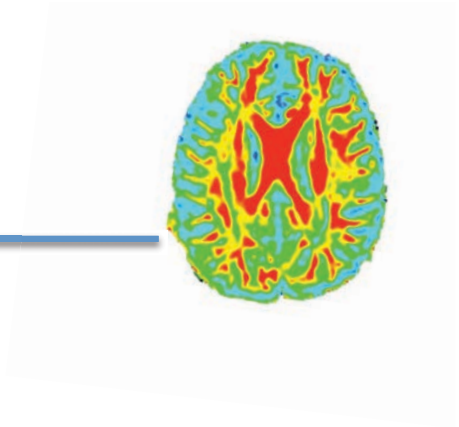
DWI



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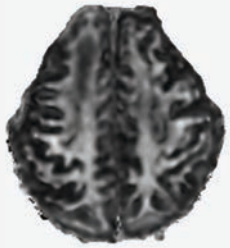

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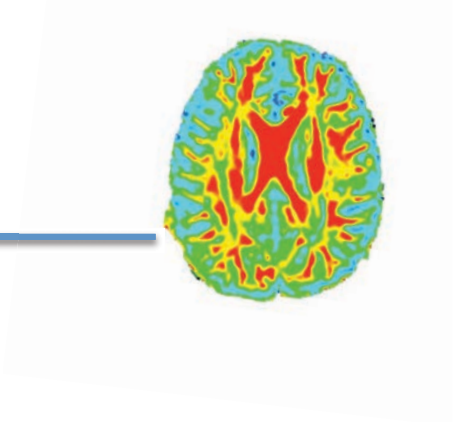
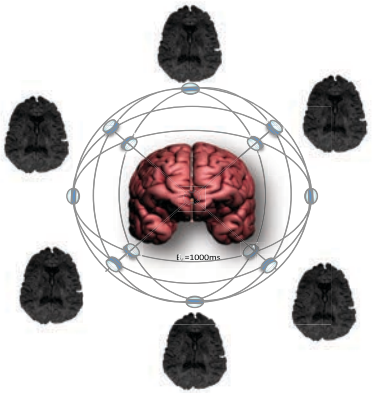
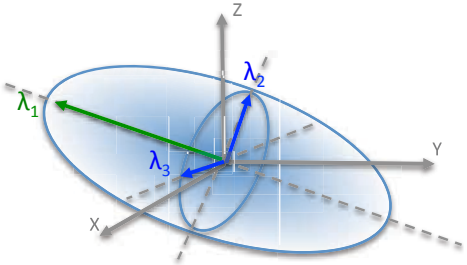


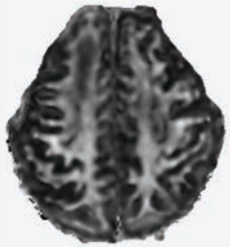


Minimum 6 directions



Cartographie en 3D

Fractionnal Anisotropy (FA)



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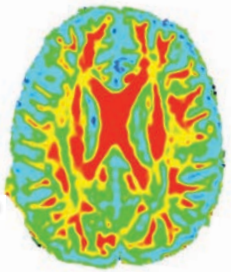
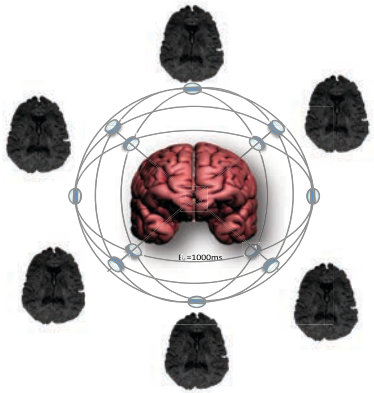
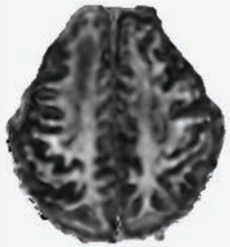
DWI



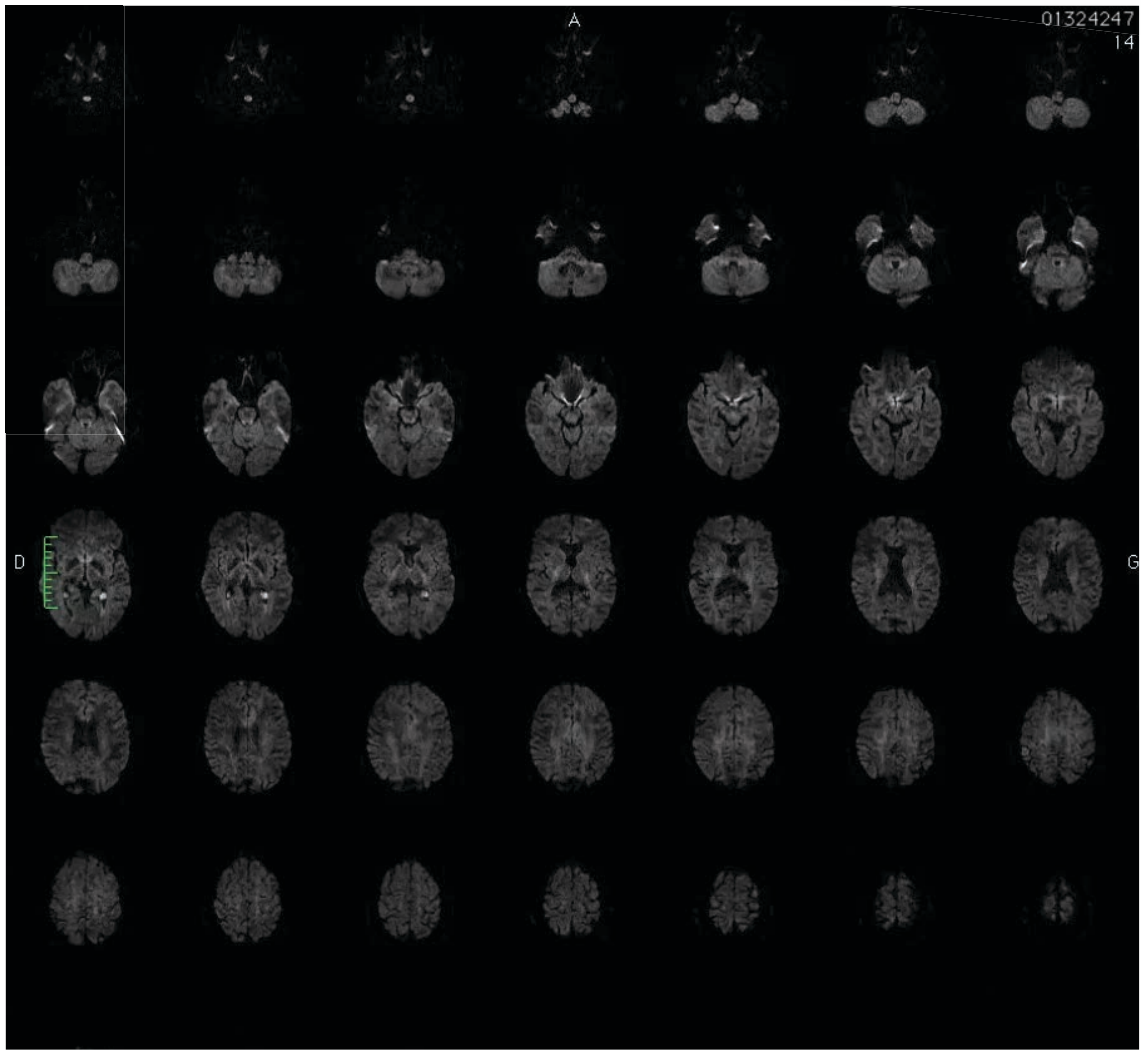


Minimum 6 directions

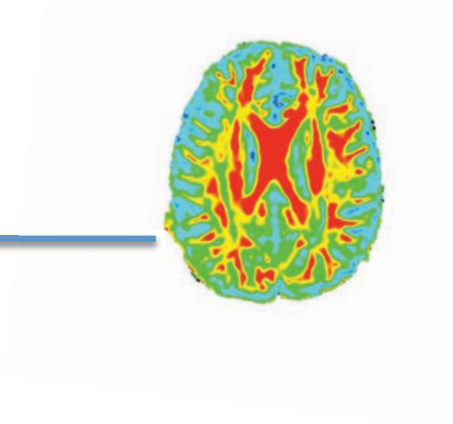
Fractionnal Anisotropy (FA)



$$FA = \sqrt{\frac{2}{3}} \cdot \sqrt{\frac{(\lambda_1 - \bar{\lambda})^2 + (\lambda_2 - \bar{\lambda})^2 + (\lambda_3 - \bar{\lambda})^2}{\lambda_1^2 + \lambda_2^2 + \lambda_3^2}}$$

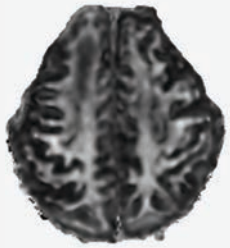


DWI



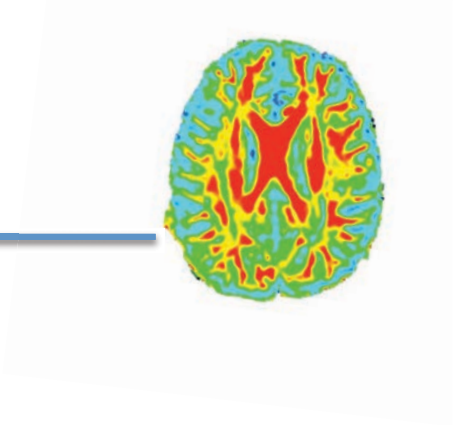
- L1= diffusivité axiale
- Lt=diffusivité radiale

Fractionnal Anisotropy (FA)



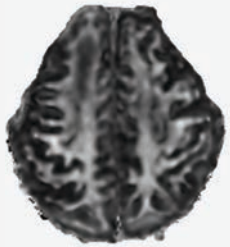
$$FA = \sqrt{\frac{2}{3}} \cdot \sqrt{\frac{(\lambda_1 - \bar{\lambda})^2 + (\lambda_2 - \bar{\lambda})^2 + (\lambda_3 - \bar{\lambda})^2}{\lambda_1^2 + \lambda_2^2 + \lambda_3^2}}$$

DWI

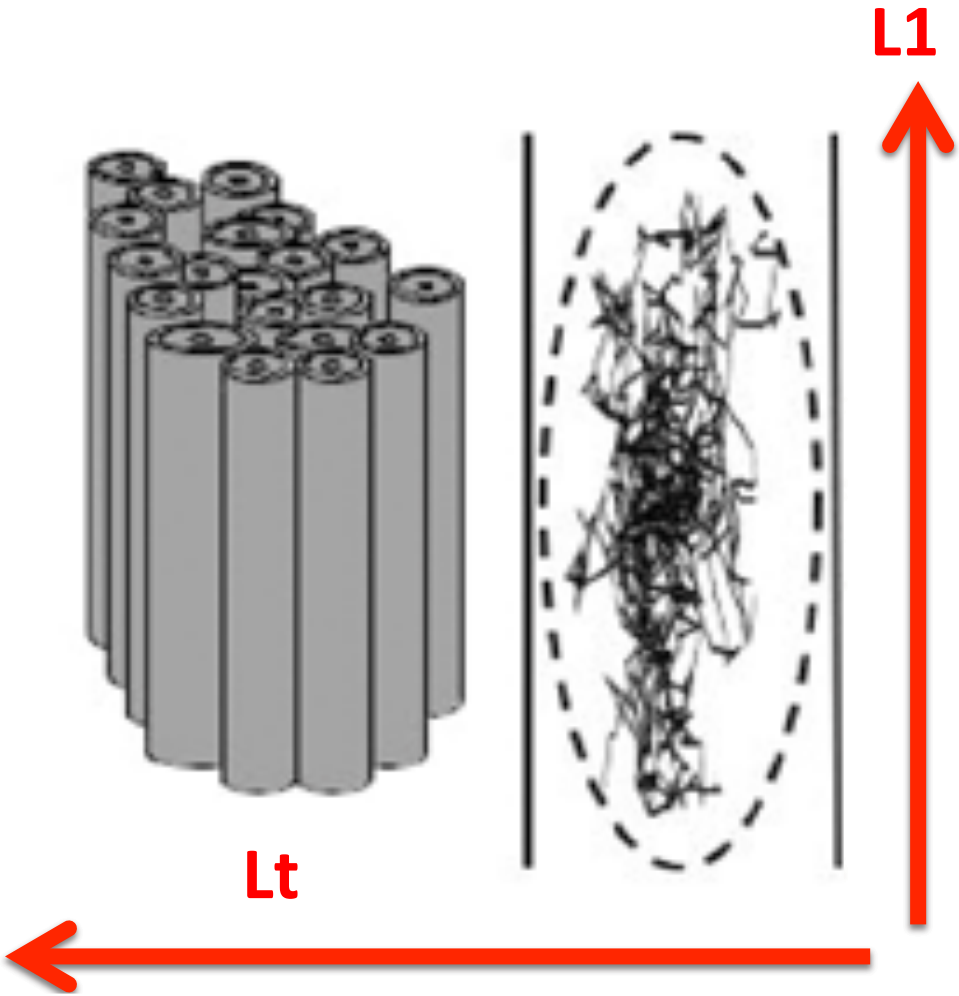


- L1= diffusivité axiale
- Lt=diffusivité radiale

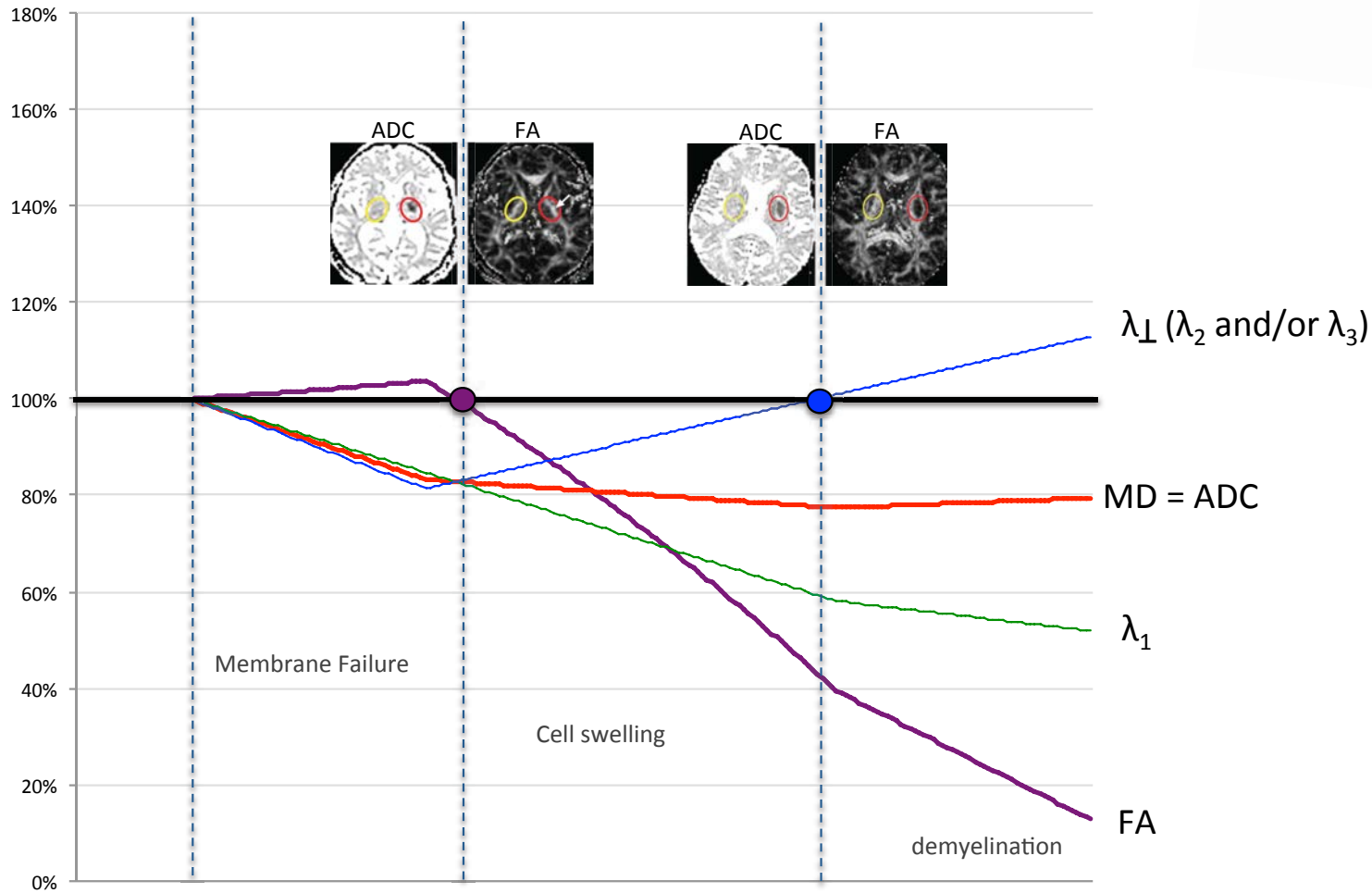
Fractionnal Anisotropy (FA)



$$FA = \sqrt{\frac{2}{3}} \cdot \sqrt{\frac{(\lambda_1-\bar{\lambda})^2 + (\lambda_2-\bar{\lambda})^2 + (\lambda_3-\bar{\lambda})^2}{\lambda_1^2 + \lambda_2^2 + \lambda_3^2}}$$

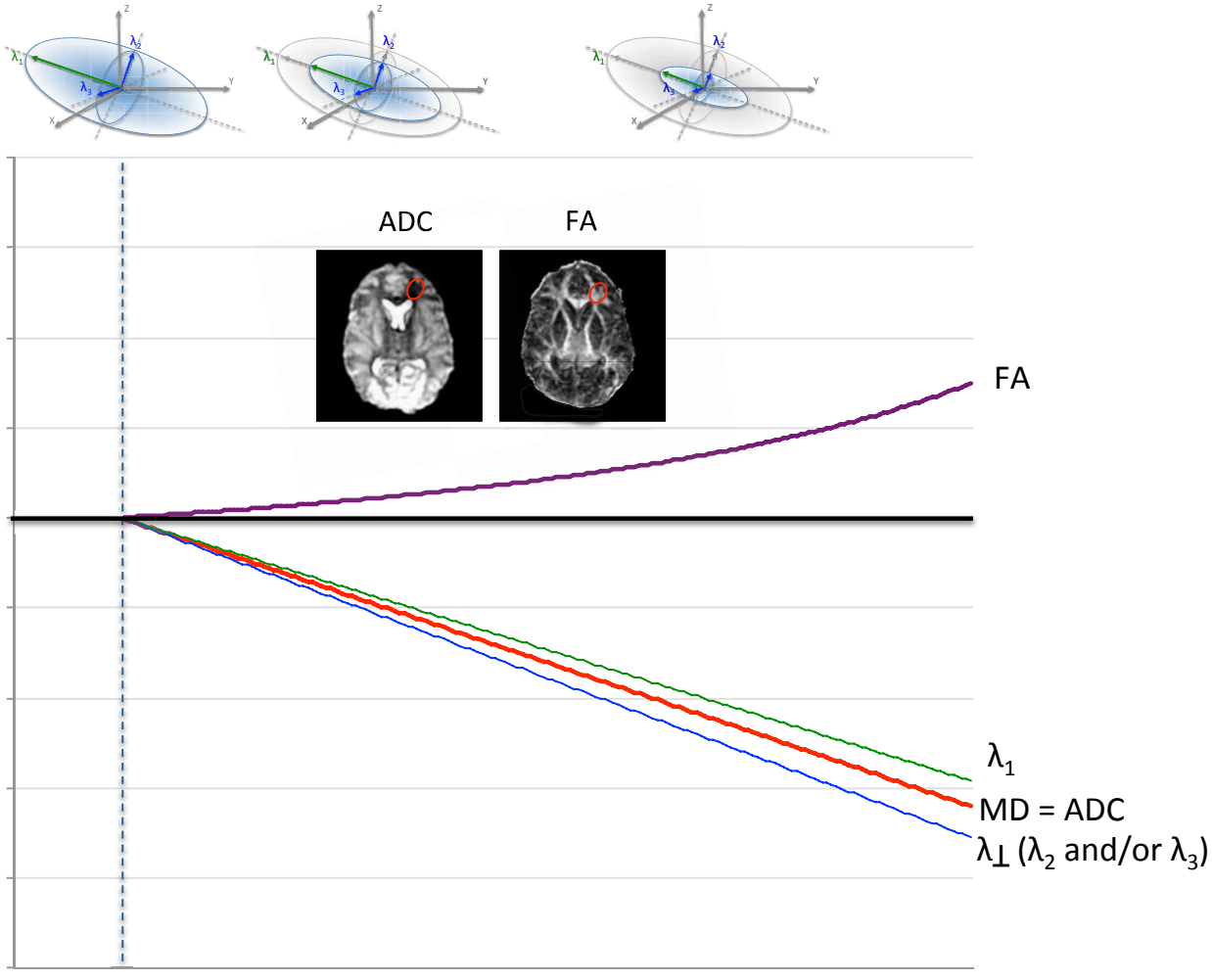


DWI & œdème cytotoxique



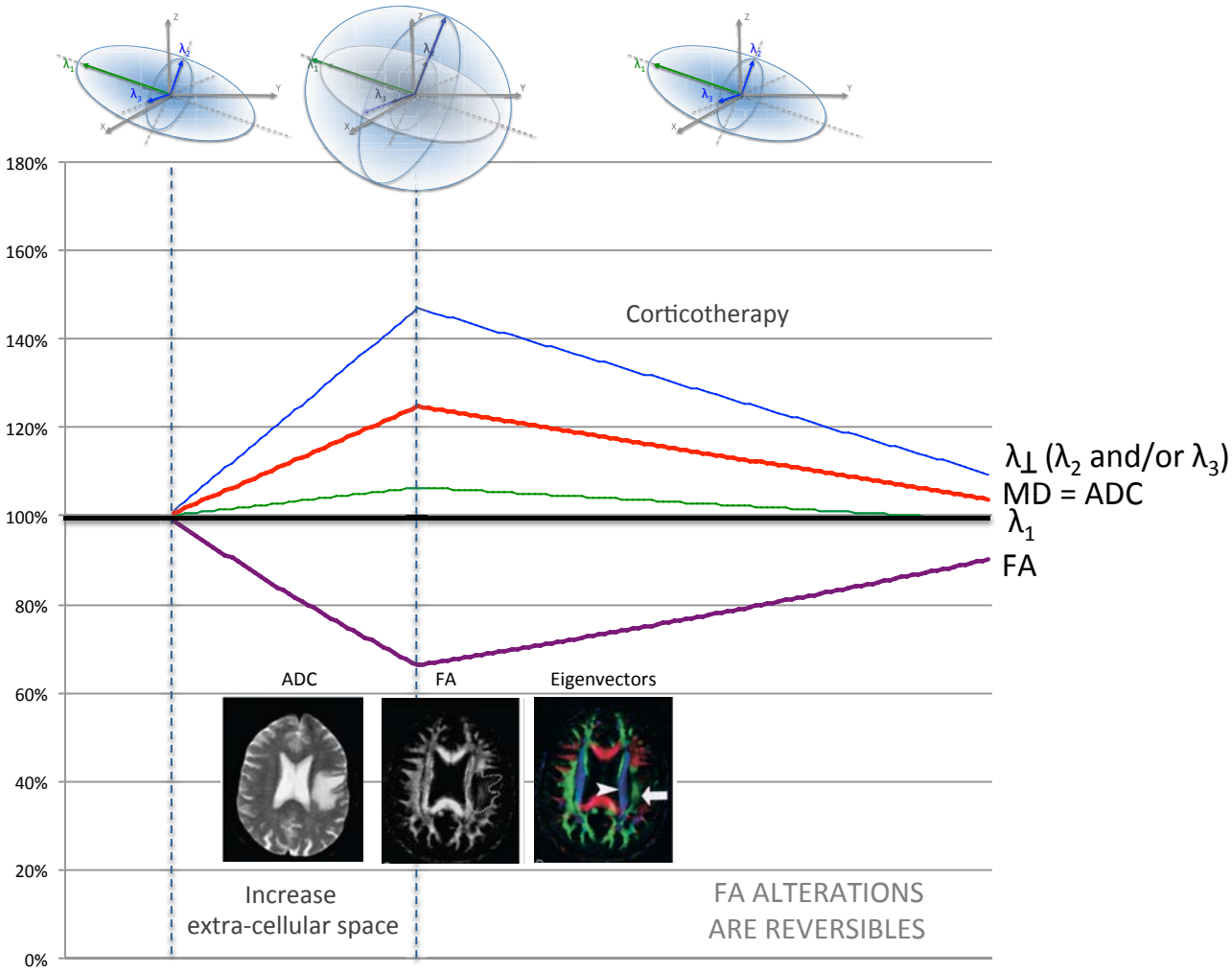
Courtesy from Lionel Velly

DWI & Ischémie aiguë



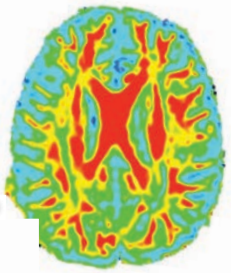
Courtesy from Lionel Velly

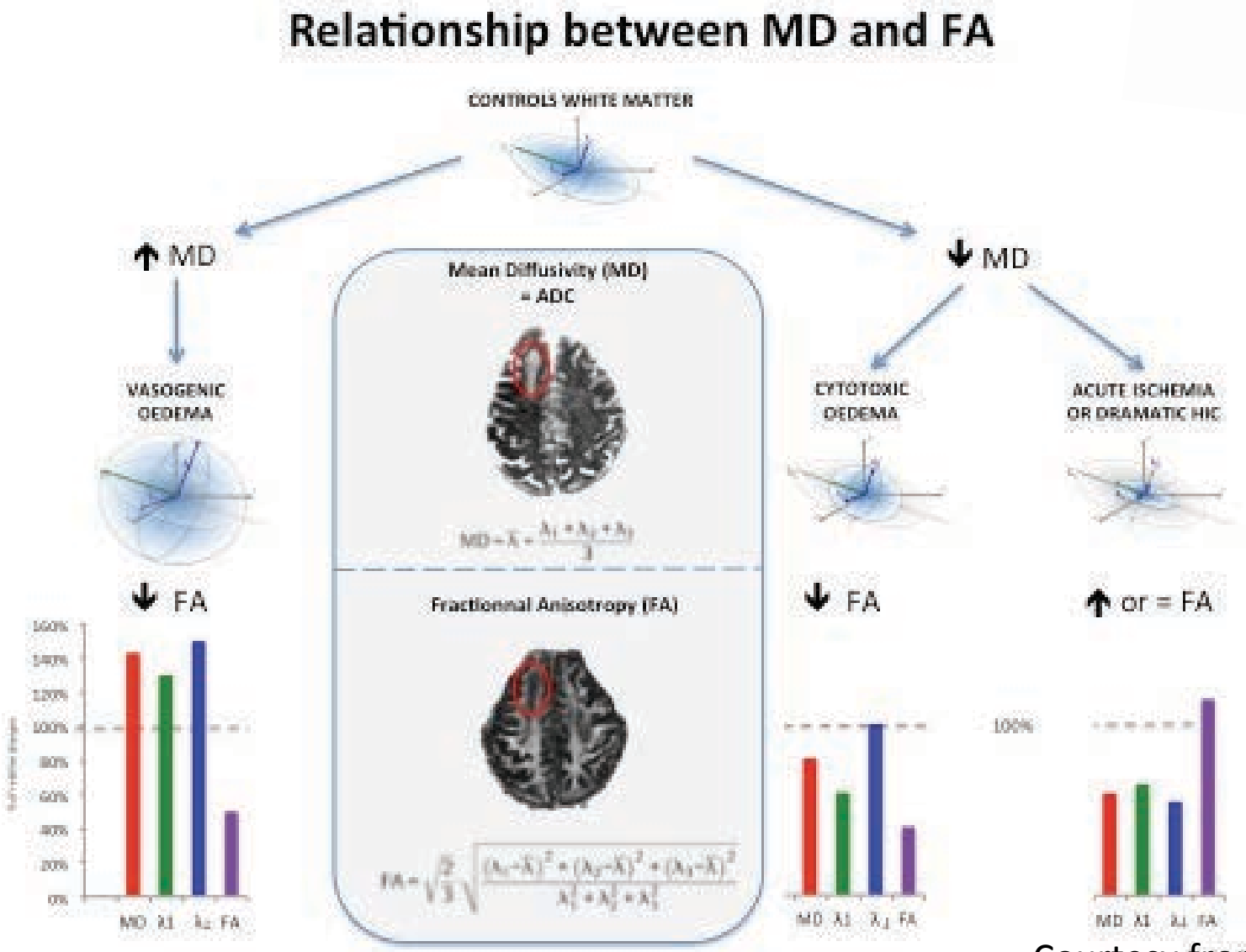
DWI & œdème vasogénique



Courtesy from Lionel Velly

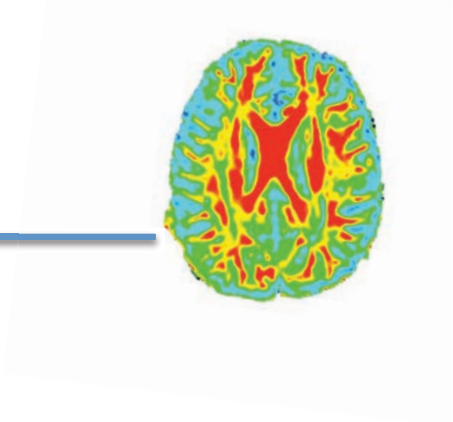
DWI Résumé





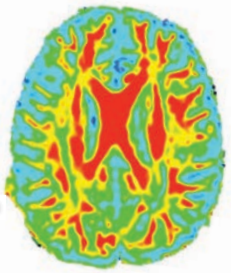
Courtesy from Lionel Velly

Plan



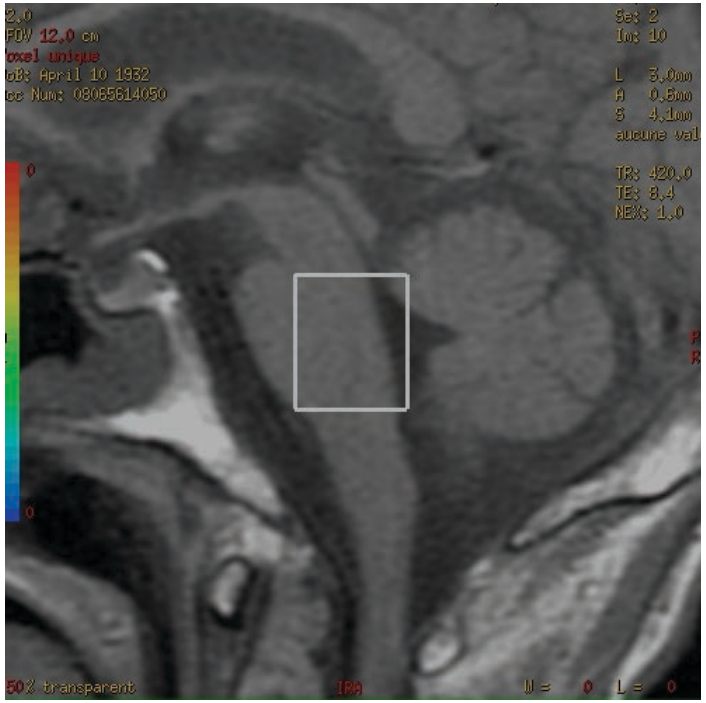
- IRM morphologique rappels
- IRM en tenseur de diffusion
- Spectro-IRM
- IRM fonctionnelle-RS-BOLD
- Applications

Spectro-IRM

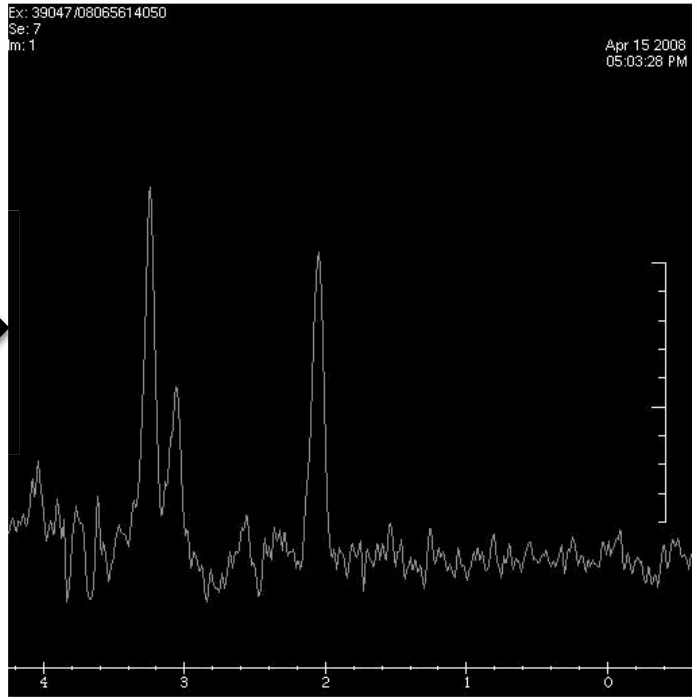


- Chaque métabolite a une fréquence de résonance différente
- Dans un voxel donné on peut mesurer la concentration d'un métabolite donné
- La créatine est pris comme référence (stable)
- La choline reflète le métabolisme membranaire
- Le N-acétyl-aspartate (NAA) est un marqueur de la souffrance neuronale

Spectro-IRM



Transformée de Fourrier



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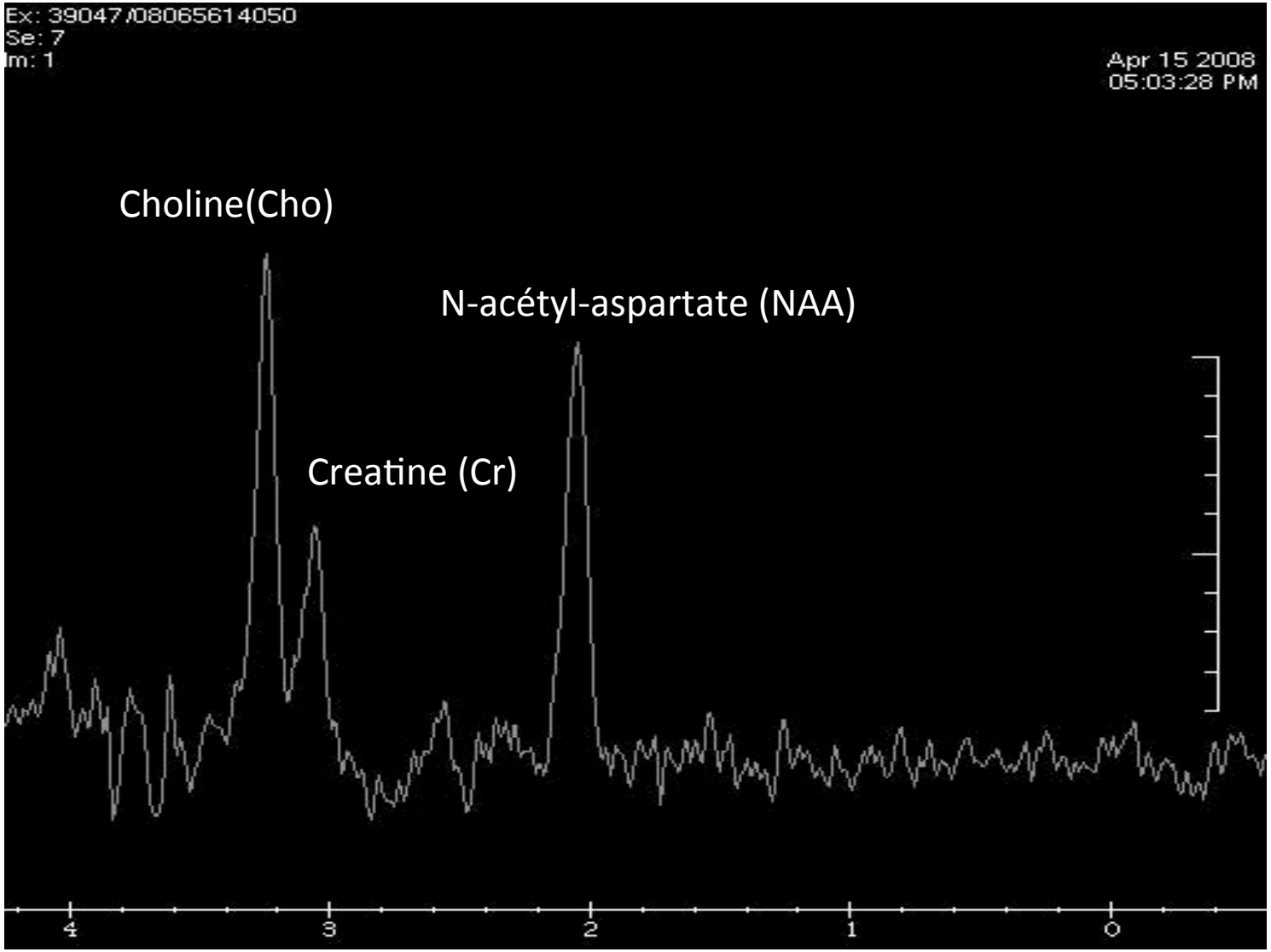
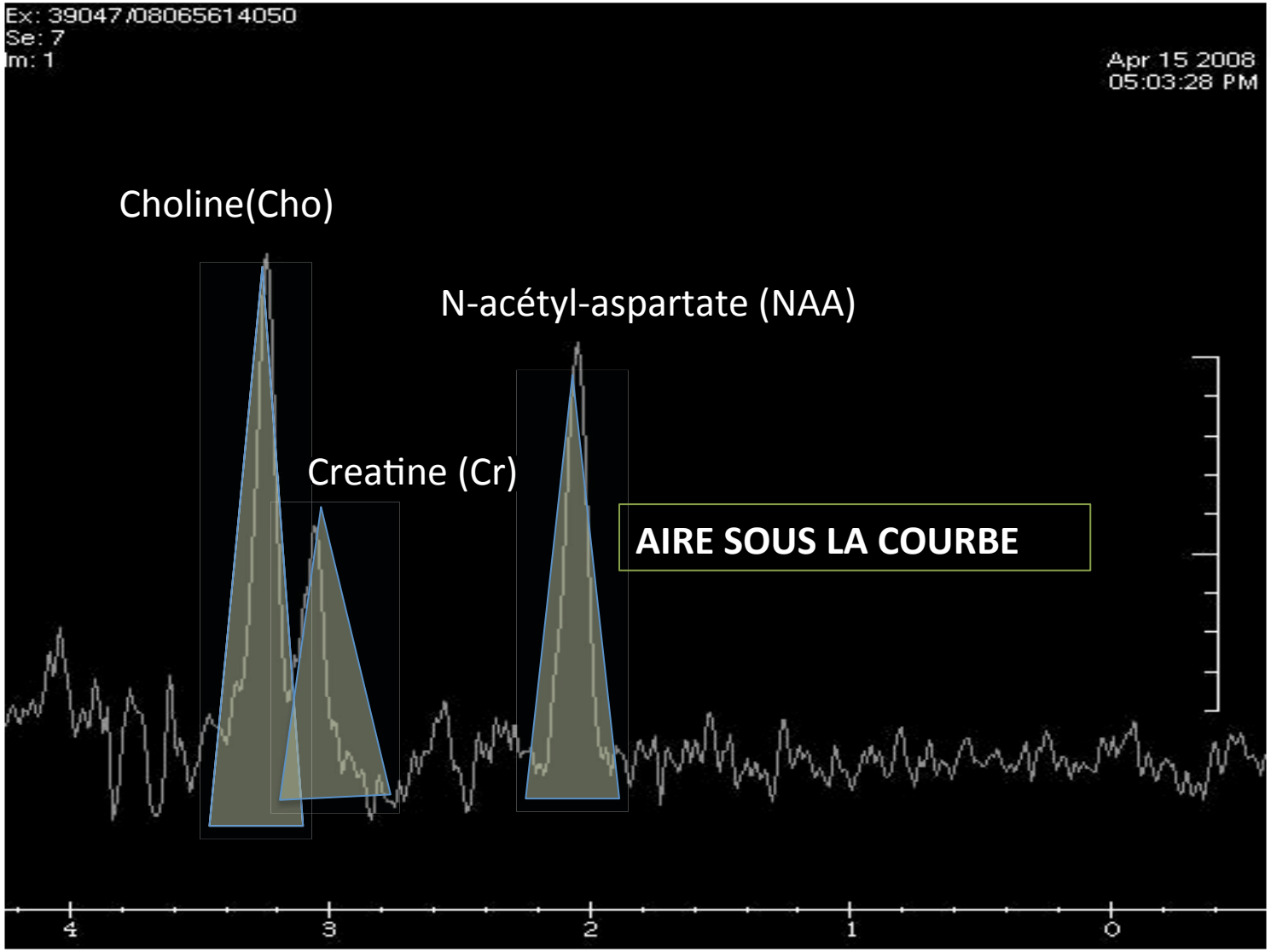
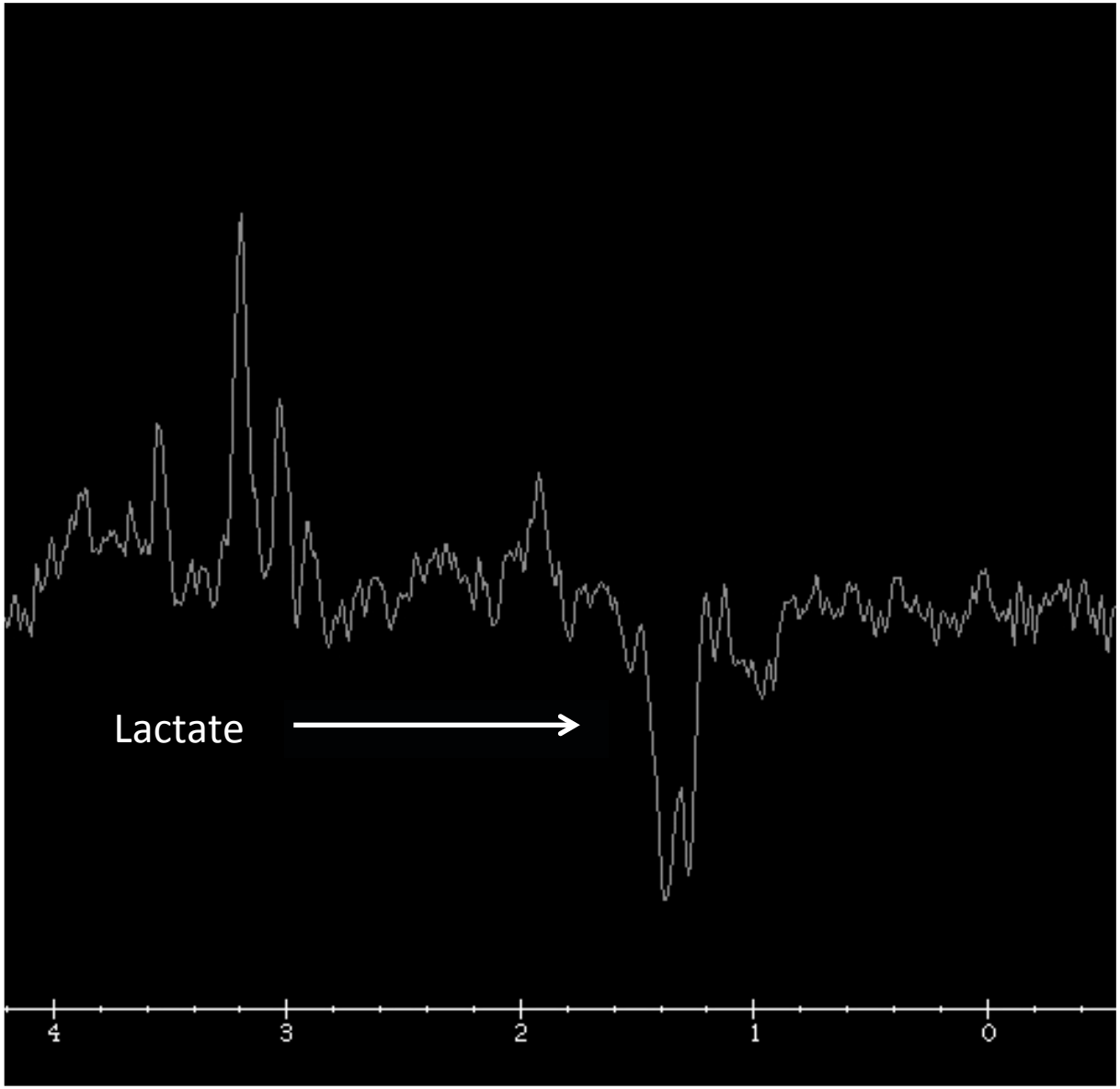

Ex: 39047/08065614050
Se: 7
Im: 1
Apr 15 2008
05:03:28 PM
Choline(Cho)
N-acétyl-aspartate (NAA)
Creatine (Cr)
4
3
2
1
0

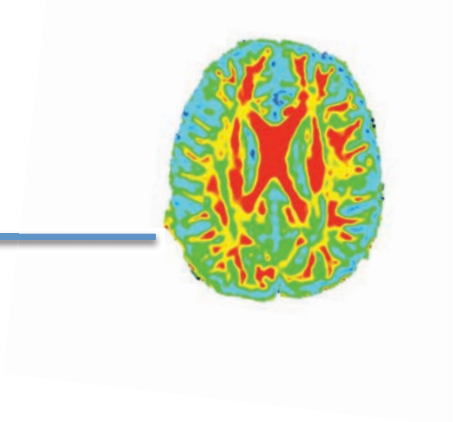
Spectro-IRM


Ex: 39047/08065614050
Se: 7
Im: 1
Apr 15 2008
05:03:28 PM
Choline(Cho)
N-acétyl-aspartate (NAA)
Creatine (Cr)
AIRE SOUS LA COURBE
4
3
2
1
0

Spectro-IRM & Lactate



Plan



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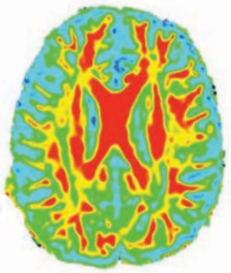
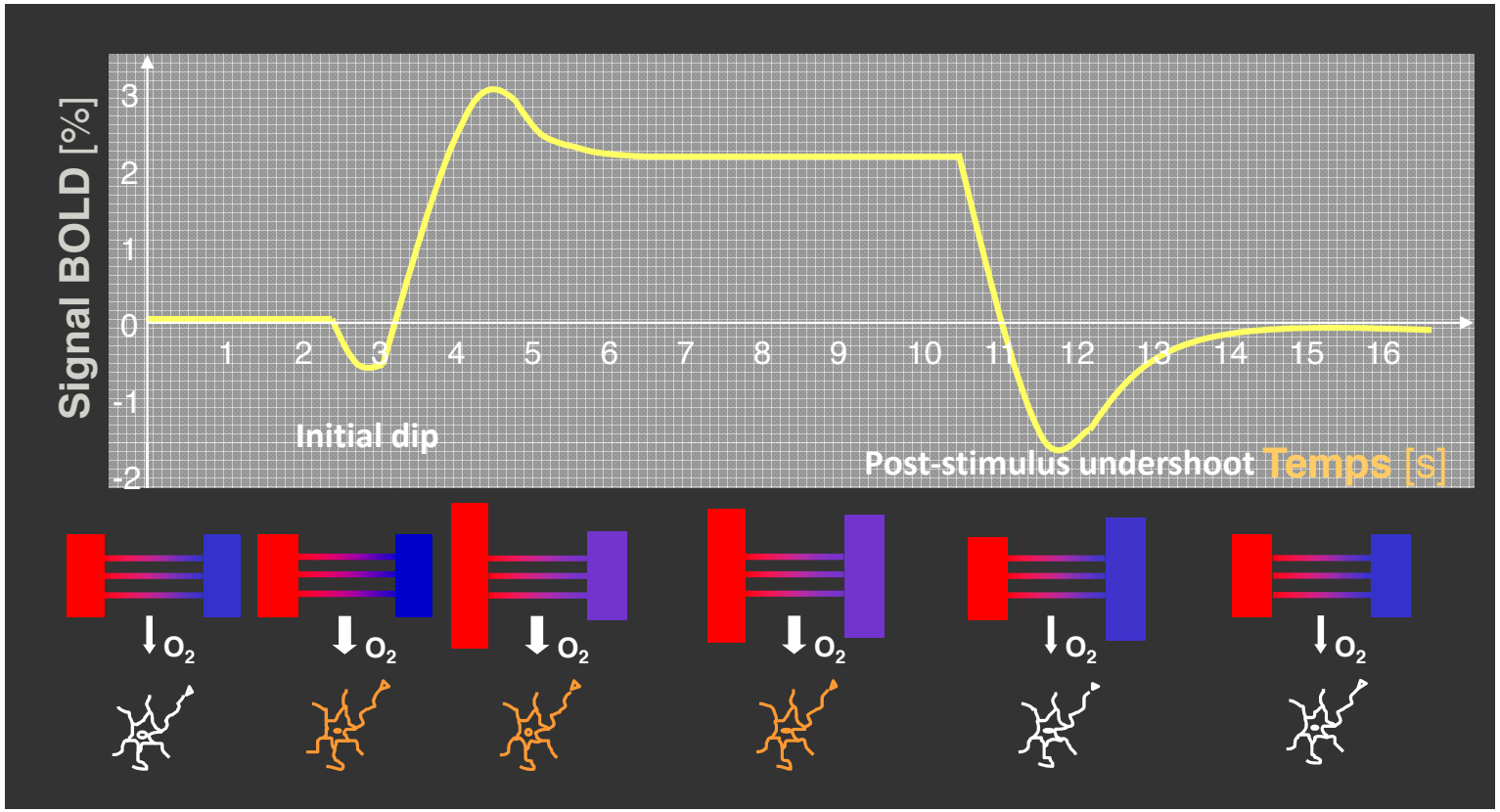
L'effet BOLD

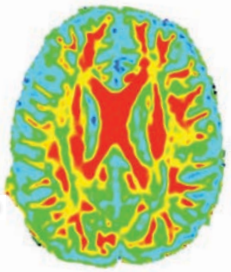


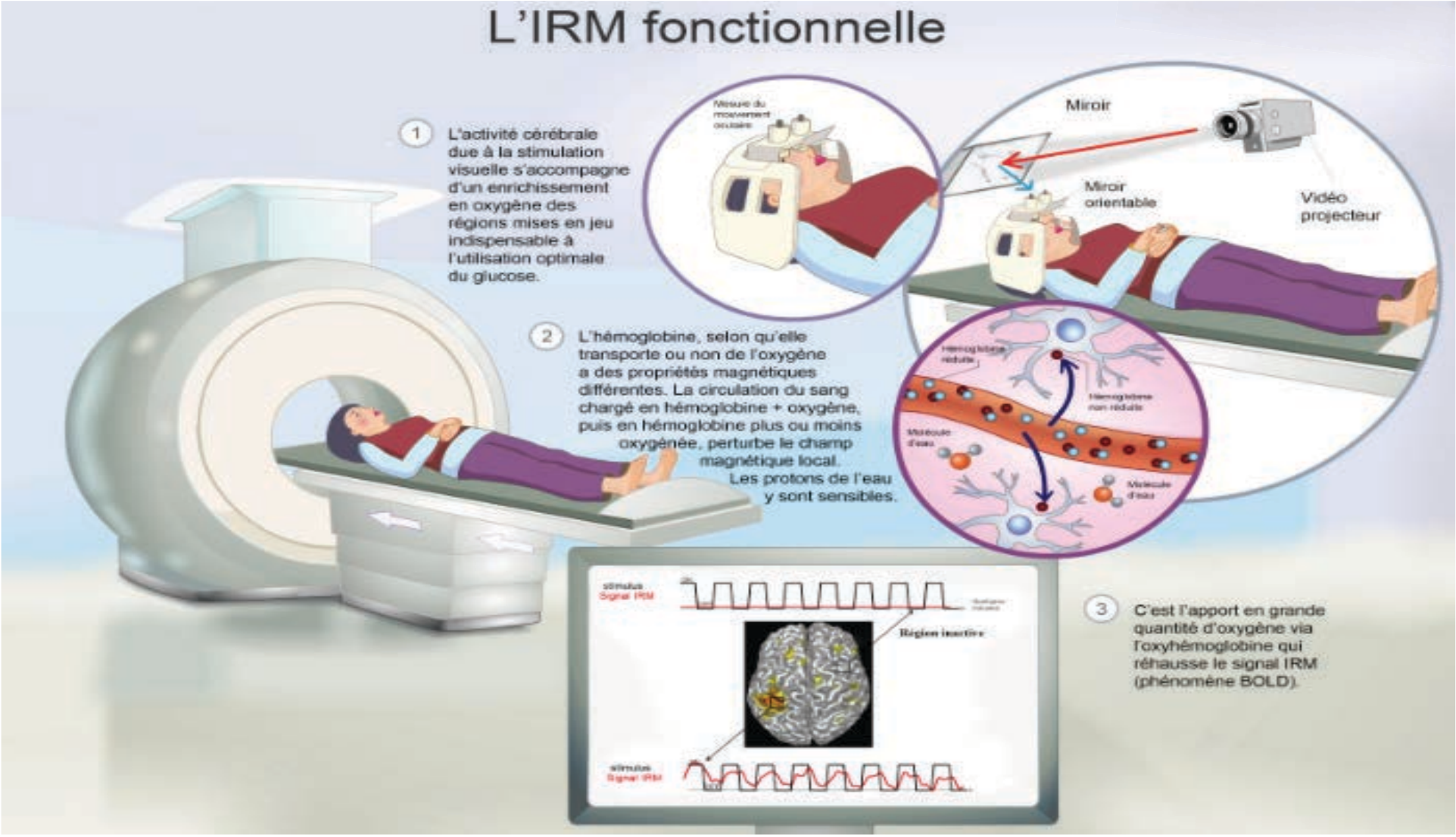
BLOOD OXYGEN LEVEL DEPENDANT



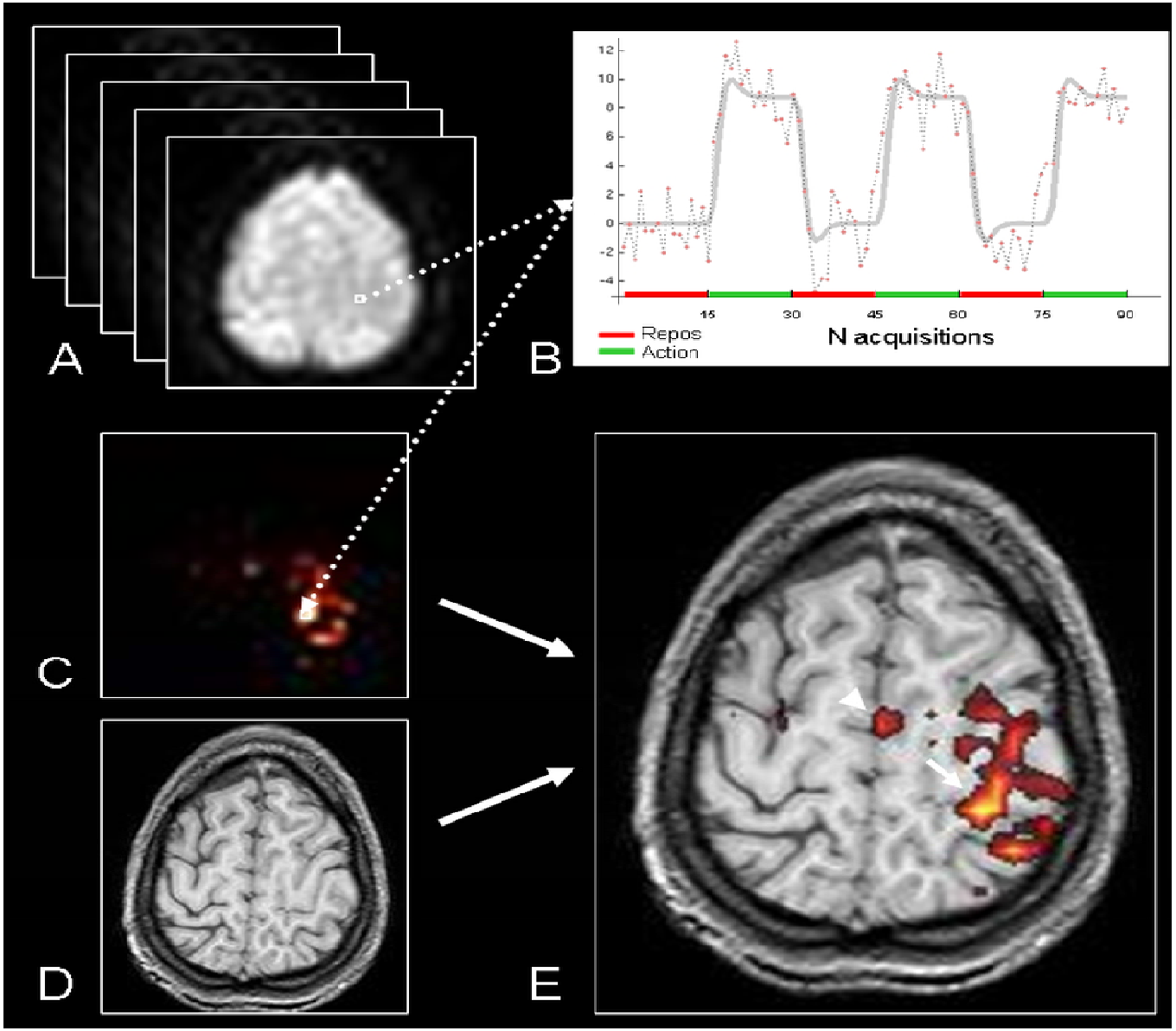
Oxy-HB sang artériel DIAMAGNETIQUE
Désoxy-Hb sang veineux PARAMAGNETIQUE

IRM fonctionnelle

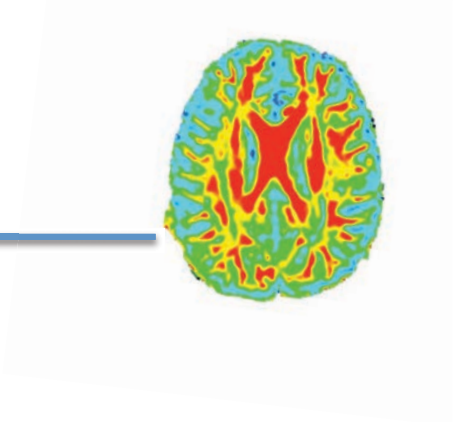




IRM fonctionnelle



Plan



- IRM morphologique rappels
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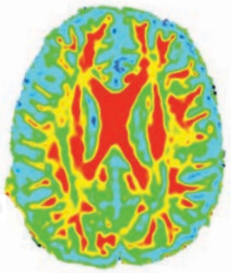
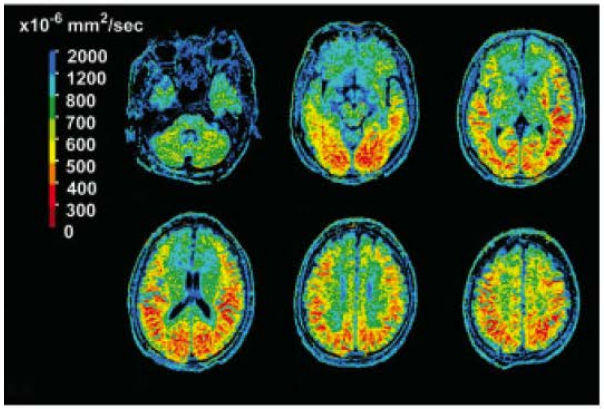
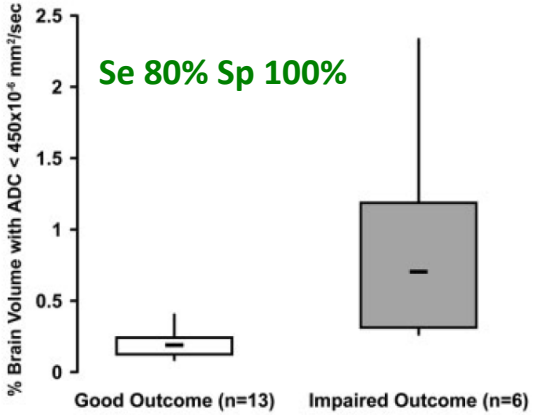
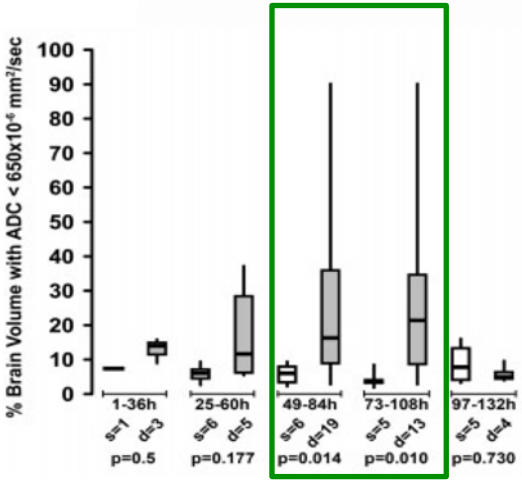
IRM multimodale & anoxie



ADC-MD







Significatif de J2 à J5

Wijman et al, Annals of neurology, 2009

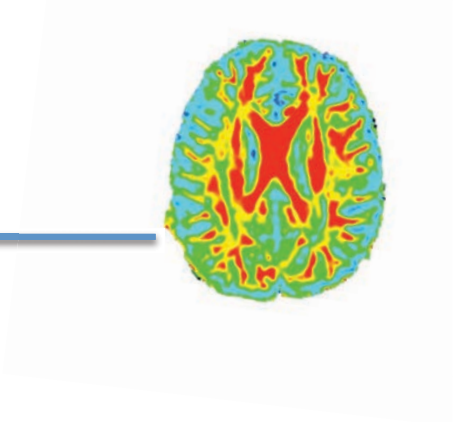
TABLE 4. Diffusion MRI Findings for Predicting Poor Neurologic Outcome at Hospital Discharge

Involved Brain Region, *n* (%)	Good Outcome	Poor Outcome	*p*	Sensitivity/ Specificity	Positive / Negative Predictive Value	AUC	*p*
Cerebral cortex							
Frontal ($n = 88$)	2 (3.7)	86 (72.9)	< 0.01	96/73	62/98	0.85	< 0.01
Parietal ($n = 98$)	2 (3.7)	96 (81.4)	< 0.01	96/81	70/98	0.89	< 0.01
Temporal ($n = 82$)	1 (1.9)	81 (68.6)	< 0.01	98/69	59/99	0.83	< 0.01
Occipital ($n = 93$)	2 (3.7)	91 (77.1)	< 0.01	96/77	66/98	0.87	< 0.01
Basal ganglia or thalamus ($n = 55$)	0 (0.0)	55 (46.6)	< 0.01	54/47	46/100	0.73	< 0.01
Cerebellum ($n = 37$)	0 (0.0)	37 (31.4)	< 0.01	100/31	40/100	0.66	< 0.01
Brain stem ($n = 3$)	0 (0.0)	3 (2.5)	0.55	100/3	32/100	0.51	0.79
MRI positive finding[a]	4 (7.4)	102 (86.4)	< 0.01	93/86	76/96	0.90	< 0.01
≤ 3 d ($n = 146$)	2 (4.9)	92 (87.6)	< 0.01	95/88	75/98	0.91	< 0.01
> 3 d ($n = 26$)	2 (15.4)	10 (76.9)	< 0.01	85/77	79/83	0.81	< 0.01
Numbers of involved lesion	0 [0–0]	4 [3–5]	< 0.01			0.93	0.02

IRM dans la 1ère semaine

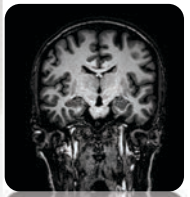
Seung Mok et al, CCM, 2015

IRM multimodale & anoxie

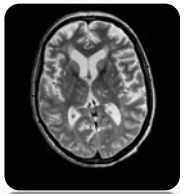


Le DWI à la Pitié Salpêtrière :

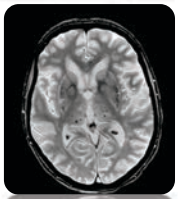
3D-T1
IR-FSPGR (GE)
MPR (Siemens / Philips)



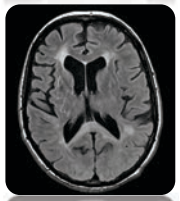
T2 (2mm)



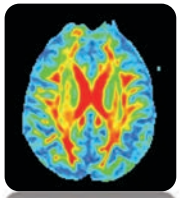
T2* or SWI



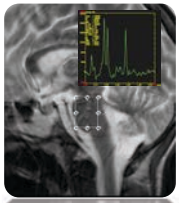
T2 FLAIR (3 mm)



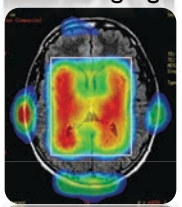
DTI



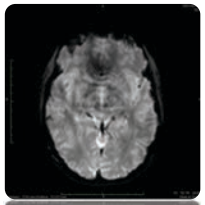
MRS
SVS pons



CSI basal ganglia

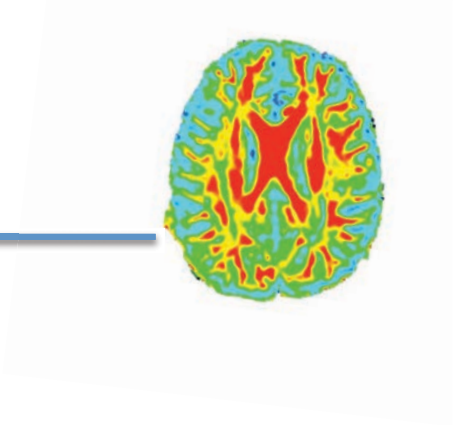


fMRI rs
(optional)

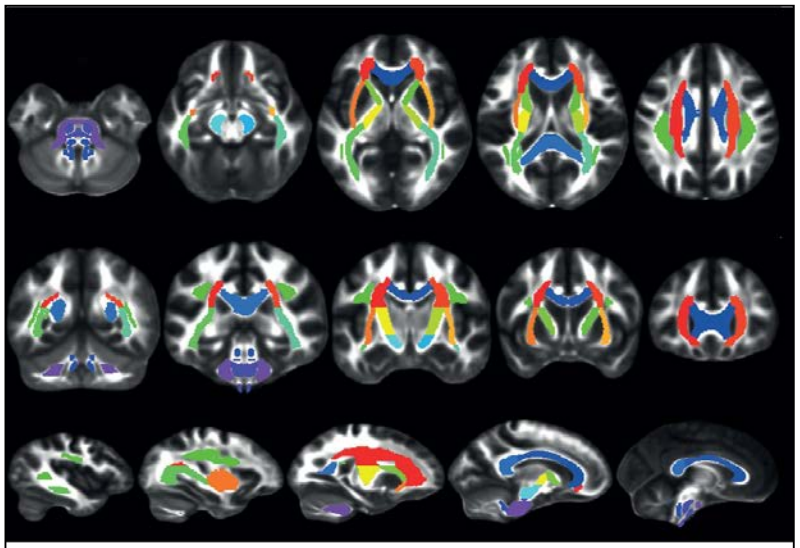


Idéalement à partir de J7 si patient toujours dans le coma

IRM multimodale & anoxie



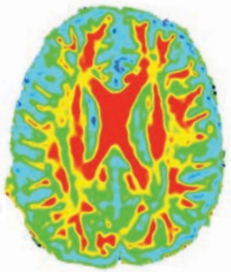
Le DWI à la Pitié Salpêtrière



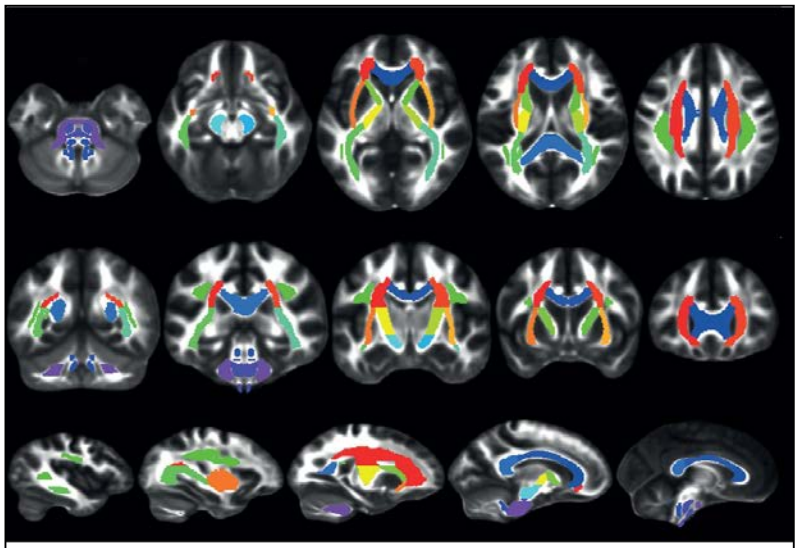
	Number	Abbreviation	Region
Posterior fossa	1	MCP	Middle cerebellar peduncle
	2	antBS	Anterior brainstem (pons, medulla oblongata)
	3	postBS	Posterior brainstem (pons, medulla oblongata)
	7	CP_R	Right cerebral peduncle
	8	CP_L	Left cerebral peduncle
Deep brain	4	gCC	Genu of the corpus callosum
	5	bCC	Body of the corpus callosum
	6	sCC	Splenium of the corpus callosum
	13	ALIC_R	Anterior arm of the internal capsule (right)
	14	ALIC_L	Anterior arm of the internal capsule (left)
	15	PLIC_R	Posterior arm of the internal capsule (right)
	16	PLIC_L	Posterior arm of the internal capsule (left)
Superficial regions	9	SS_R	Stratum sagittale (right)
	10	SS_L	Stratum sagittale (left)
	11	SLF_R	Superior longitudinal fasciculus (right)
	12	SLF_R	Superior longitudinal fasciculus (left)
	17	EC_R	External capsule (right)
	18	EC_L	External capsule (left)
	19	CR_R	Corona radiata (right)
	20	CR_L	Corona radiata (left)

20 ROI DE LA substance blanche

IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière



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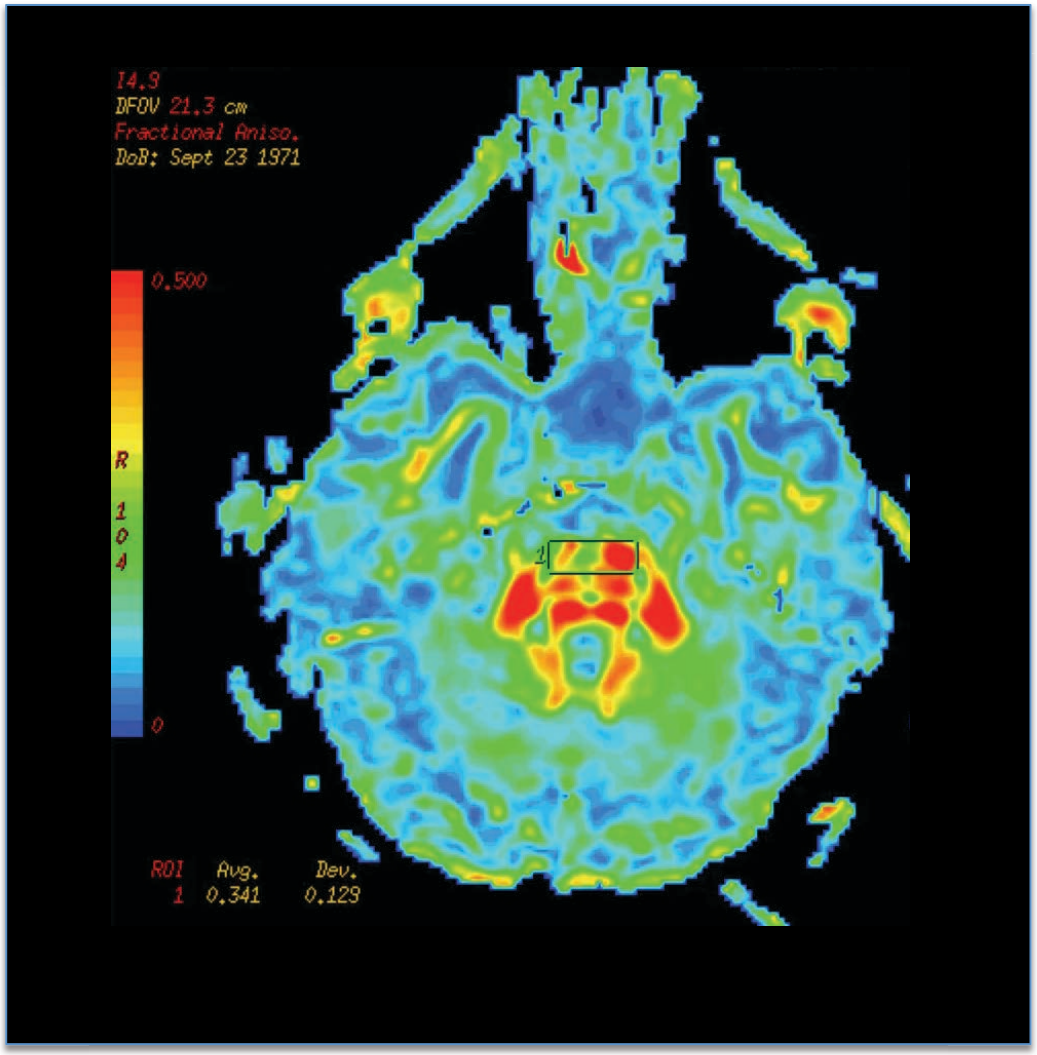
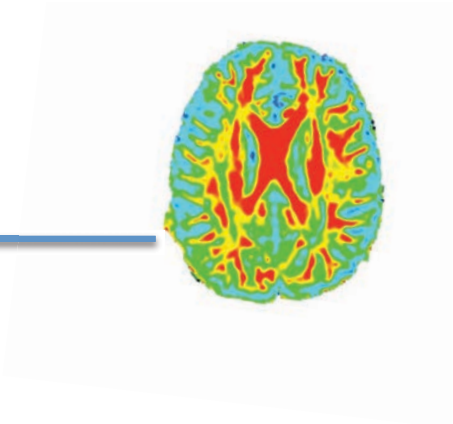
	18	EC_L	External capsule (left)
	19	CR_R	Corona radiata (right)
	20	CR_L	Corona radiata (left)



IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière :

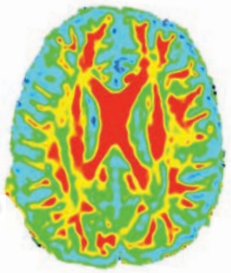
ComaSoft REPORT - 2015/12/28

DISCLAIMER
The conclusions obtained from the COMASOFT software are a diagnostic and prognostic aid. They do not substitute the decisions of clinicians, who remain responsible for their diagnoses, prognoses, prescriptions and clinical care at all times. The conclusions provided by the COMASOFT report are for informational purposes only. They do not absolve the user from the responsibility of considering all necessary details when making a decision. They cannot be used in isolation in any circumstance.
Consequently, AP-HP, UPMC, and Inserm are not responsible for any direct or indirect damage resulting from the use of the data, information, or results obtained from the COMASOFT software. The user accepts and recognizes that the use of this information is under his/her sole and exclusive responsibility.

DECHARGE DE RESPONSABILITE
Les conclusions obtenues grace au systeme logiciel COMASOFT constituent une aide au diagnostic et au pronostic. Elles ne se substituent pas aux decisions cliniques des praticiens qui demeurent responsables de leur diagnostic, de leur pronostic, de leurs prescriptions et de leur prise en charge en toutes circonstances. Les conclusions fournies par l outil a travers le rapport COMASOFT le sont a titre indicatif. Elles ne sauraient dispenser l utilisateur de reunir tous les arguments necessaires a sa decision. Elles ne peuvent en aucun cas etre utilisees de maniere isolee.
En consequence, l AP-HP, l UPMC et l Inserm ne pourront en aucun cas etre tenus responsables de tout dommage direct ou indirect resultant de l utilisation des donnees, informations ou resultats issus de ce systeme logiciel COMASOFT. L utilisateur reconnait utiliser ces informations sous sa seule responsabilite exclusive.

PATIENT REFERENCE :	mis01171garje_20151225
PATIENTS AGE :	52
DTI CONTROLS GROUP :	ctrl_psl_3t_50d_85_mask_freesurfer
CLASSIFIER :	AC_mask20_wobs_LOGwfeatselFA_N=100_2013/10/25
TRAINING GROUP :	N=100_Male=74_UFO=78_age=50(+-17)
UFO SCORE :	**0.601**

IRM multimodale & anoxie



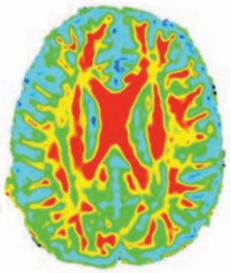
Le DWI à la Pitié Salpêtrière : WM-FA

Patient	FA	MD	L1	Lt
Whole Brain	0.952	1.134	1.118	1.146
White matter	0.913	1.126	1.078	1.184
Grey matter	0.968	1.134	1.126	1.139

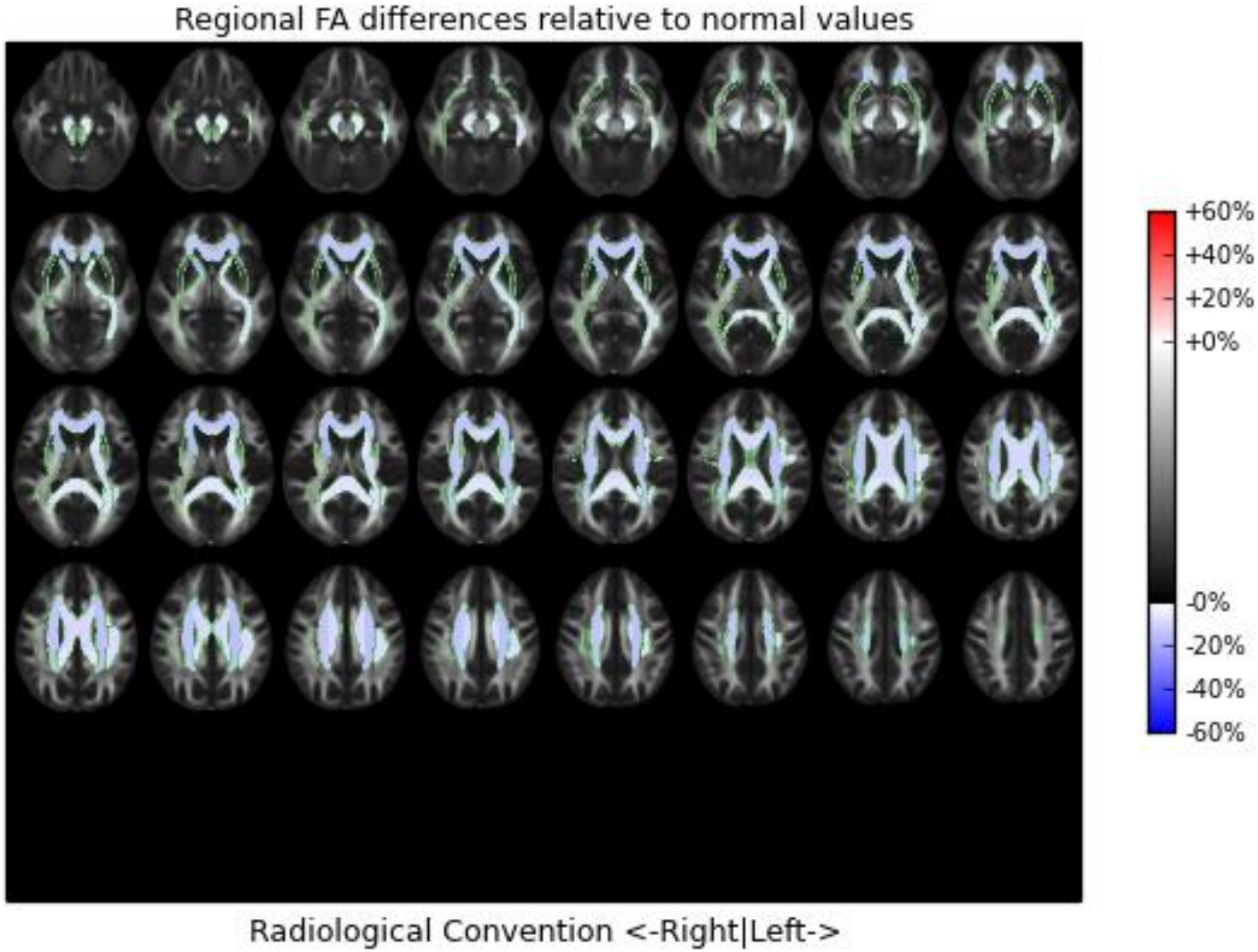
+-1*SD Controls	FA	MD	L1	Lt
Whole Brain	0.984-1.016	0.972-1.028	0.977-1.023	0.968-1.032
White matter	0.97-1.03	0.968-1.032	0.979-1.021	0.95-1.05
Grey matter	0.97-1.03	0.968-1.032	0.979-1.021	0.95-1.05

+-2*SD Controls	FA	MD	L1	Lt
Whole Brain	0.968-1.032	0.944-1.056	0.954-1.046	0.936-1.064
White matter	0.94-1.06	0.936-1.064	0.958-1.042	0.9-1.1
Grey matter	0.94-1.06	0.936-1.064	0.958-1.042	0.9-1.1

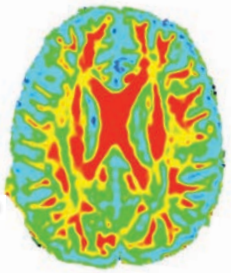
IRM multimodale & anoxie



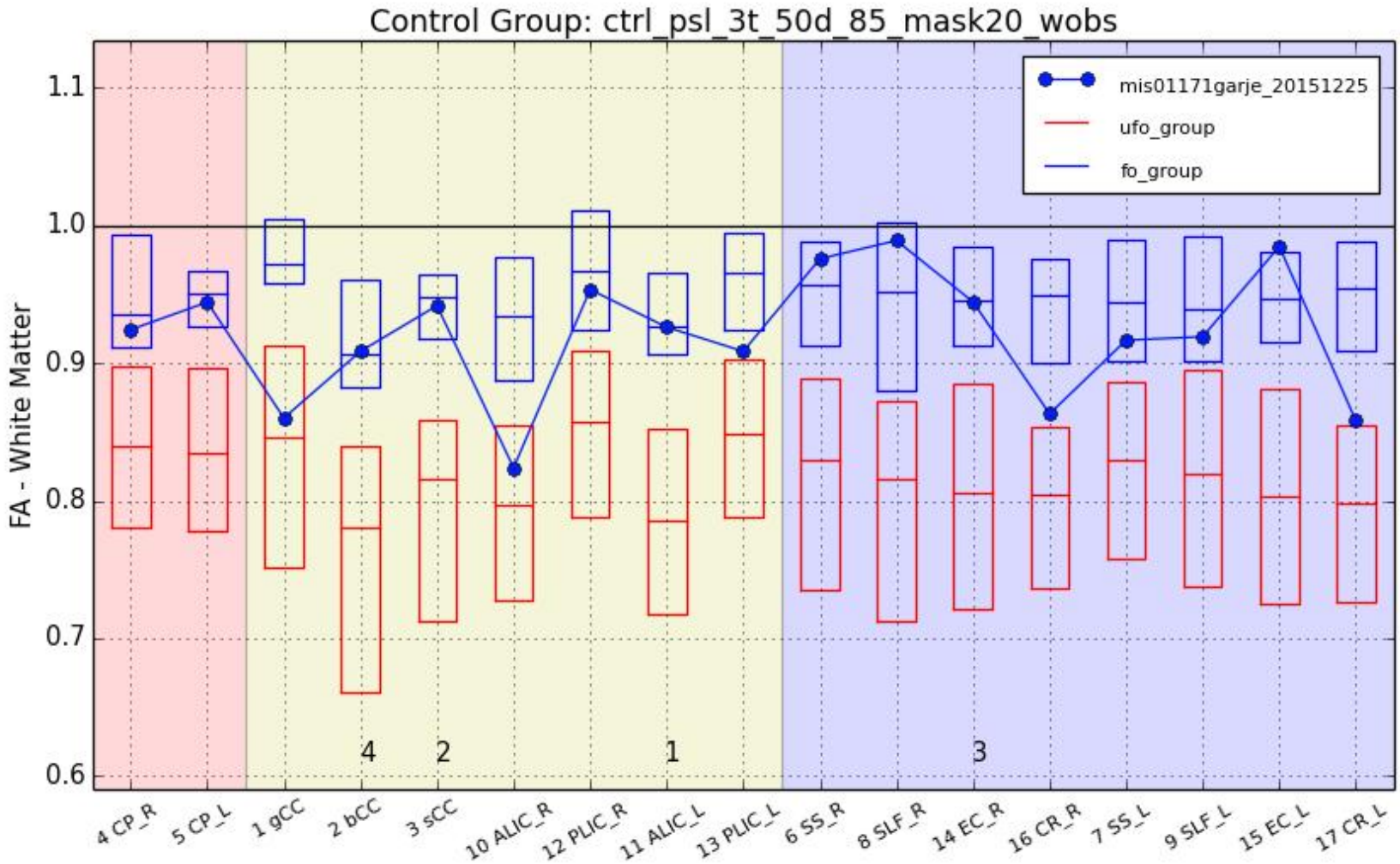
Le DWI à la Pitié Salpêtrière : WM-FA



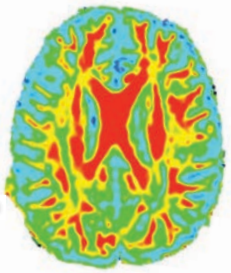
IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière : WM-FA



IRM multimodale & anoxie



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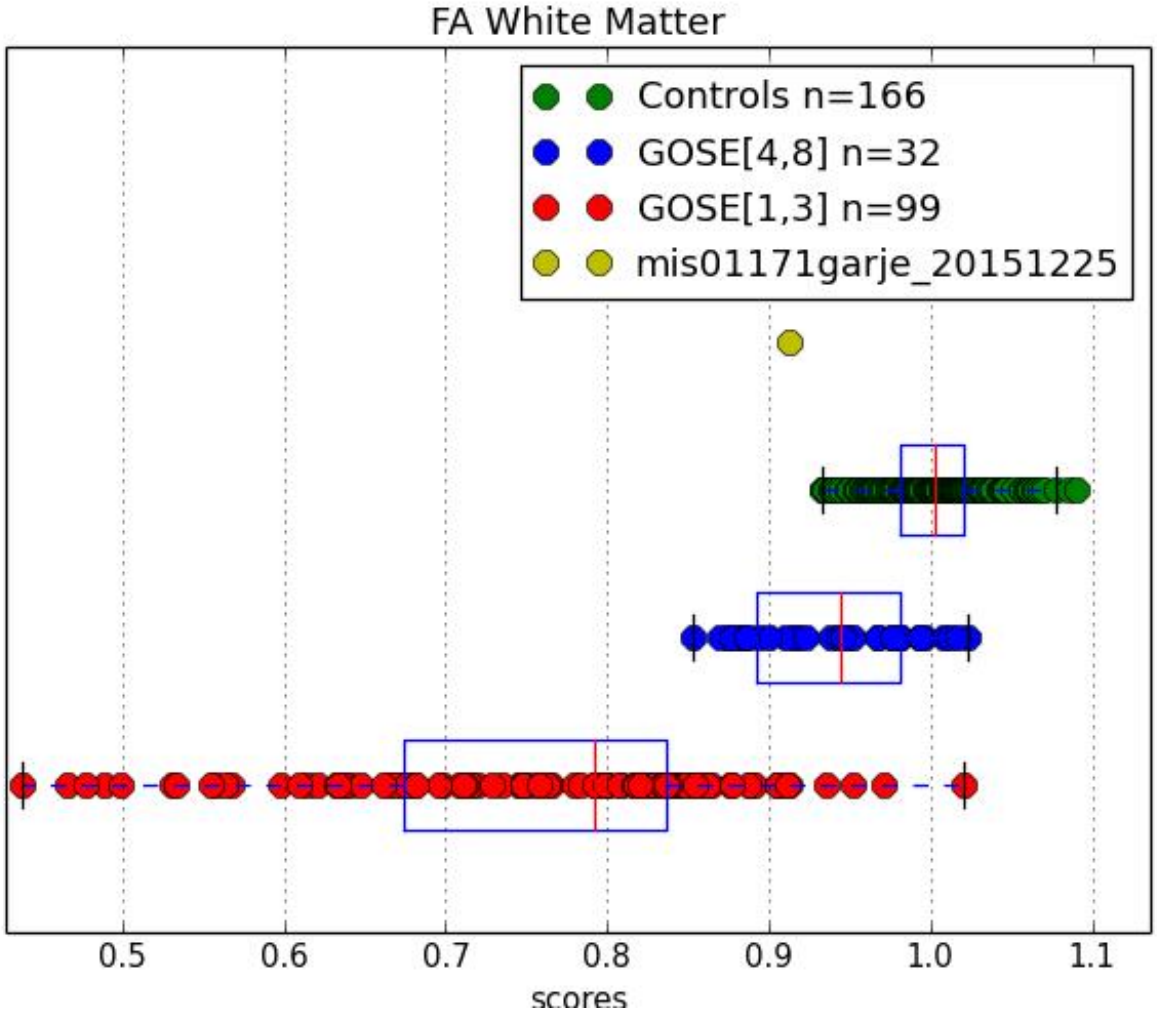
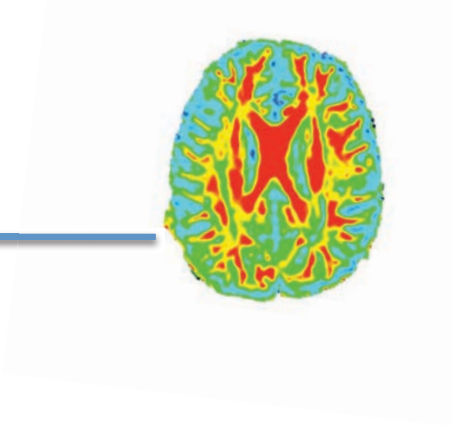
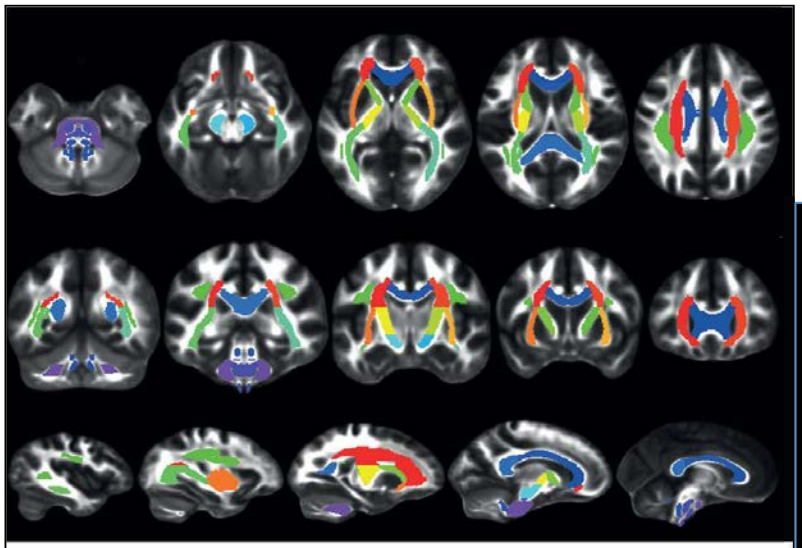


IRM multimodale & anoxie

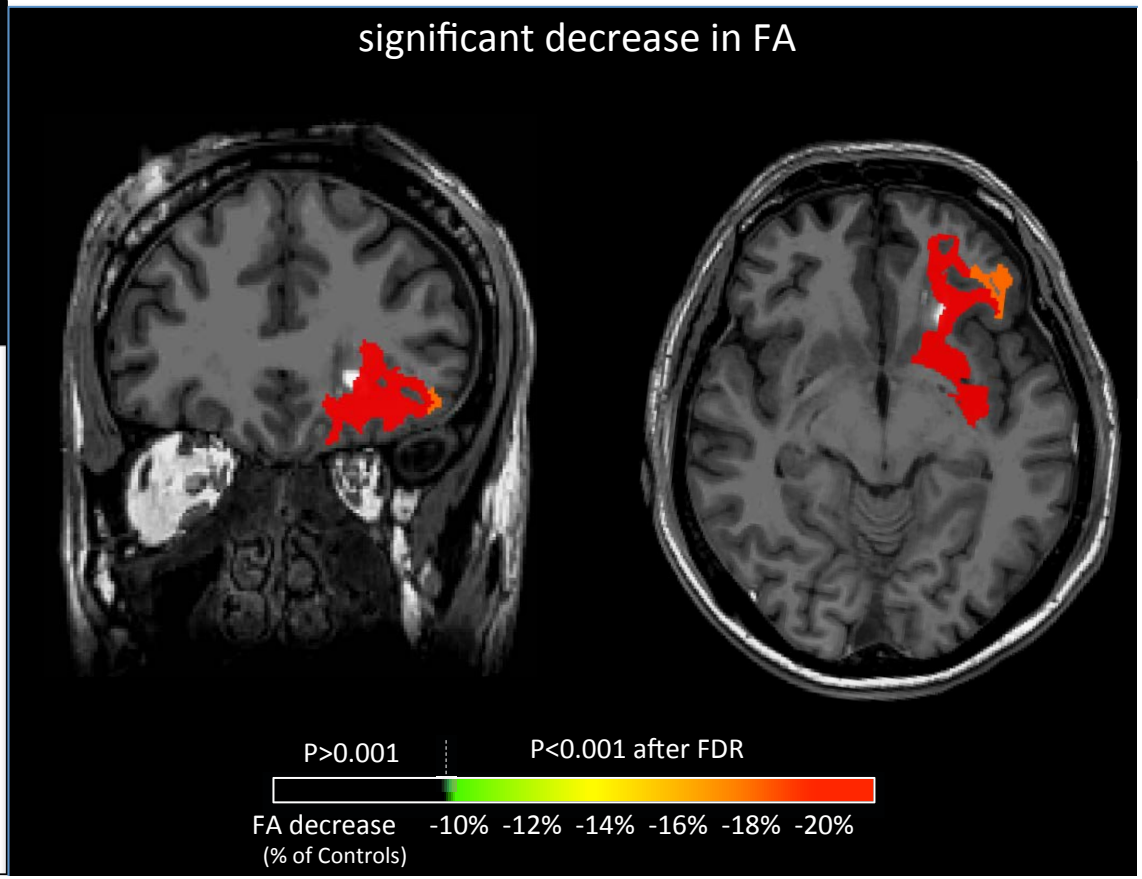


Le DWI à la Pitié Salpêtrière

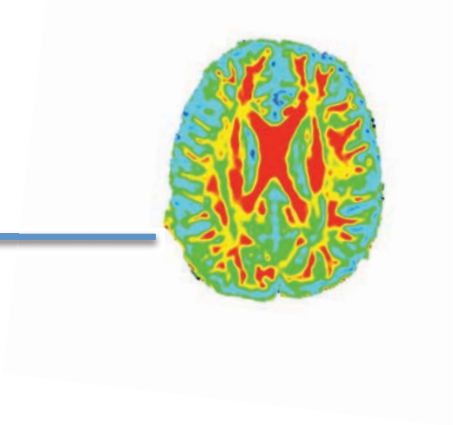


	Number	Abbreviation	Region
Posterior fossa	1	MCP	Middle cerebellar peduncle
	2	antBS	Anterior brainstem (pons, medulla oblongata)
	3	postBS	Posterior brainstem (pons, medulla oblongata)
	7	CP_R	Right cerebral peduncle
	8	CP_L	Left cerebral peduncle
Deep brain	4	gCC	Genu of the corpus callosum
	5	bCC	Body of the corpus callosum
	6	sCC	Splenium of the corpus callosum
	13	ALIC_R	Anterior arm of the internal capsule (right)
	14	ALIC_L	Anterior arm of the internal capsule (left)
	15	PLIC_R	Posterior arm of the internal capsule (right)
	16	PLIC_L	Posterior arm of the internal capsule (left)
Superficial regions	9	SS_R	Stratum sagittale (right)
	10	SS_L	Stratum sagittale (left)
	11	SLF_R	Superior longitudinal fasciculus (right)
	12	SLF_R	Superior longitudinal fasciculus (left)
	17	EC_R	External capsule (right)
	18	EC_L	External capsule (left)
	19	CR_R	Corona radiata (right)
	20	CR_L	Corona radiata (left)

Results express in % of controls

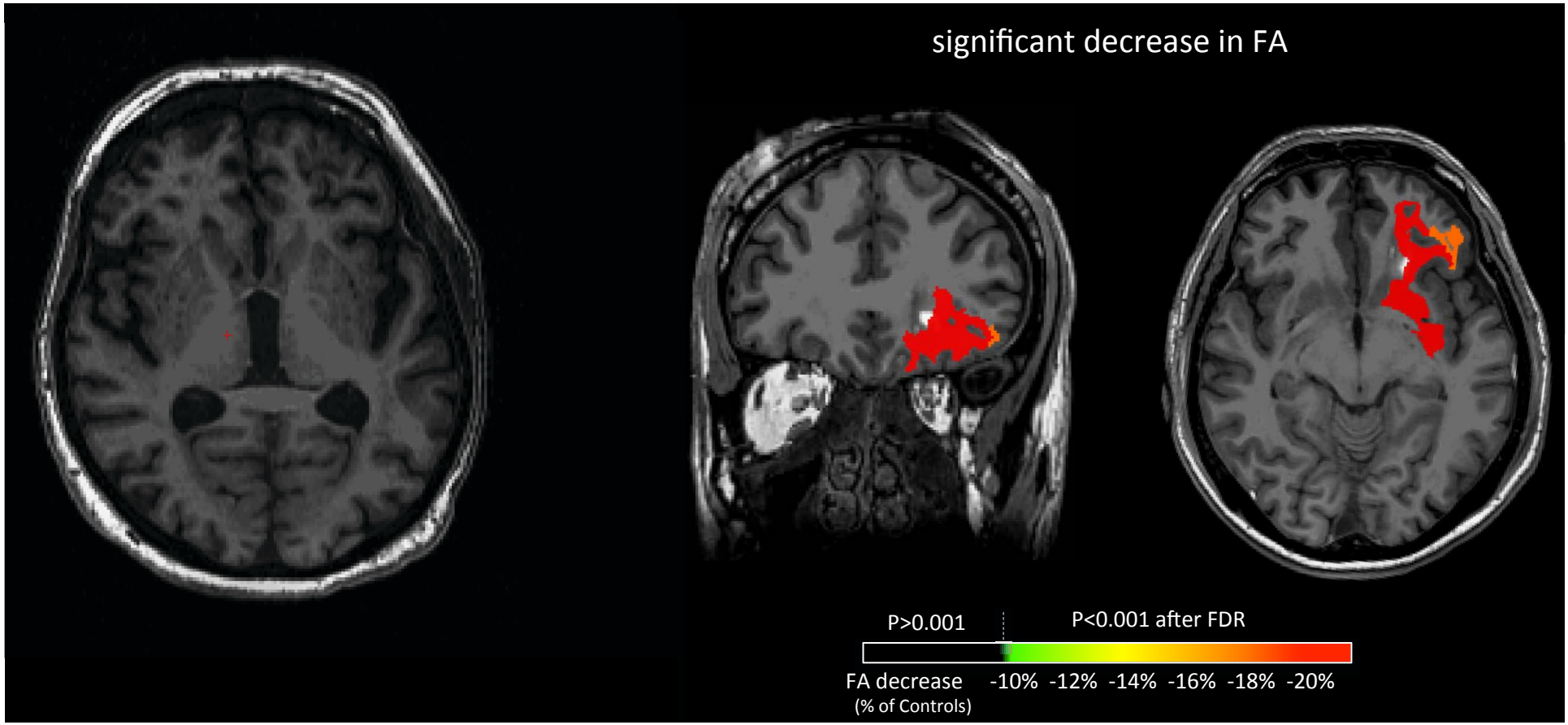


IRM multimodale & anoxie

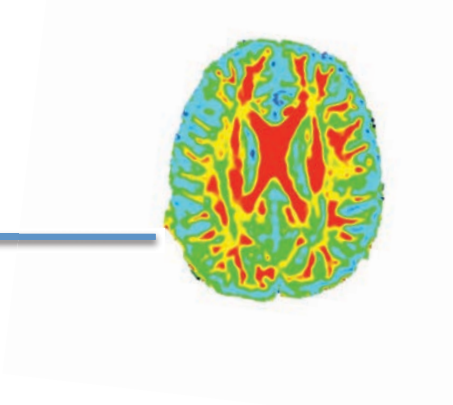


Le DWI à la Pitié Salpêtrière

Results express in % of controls

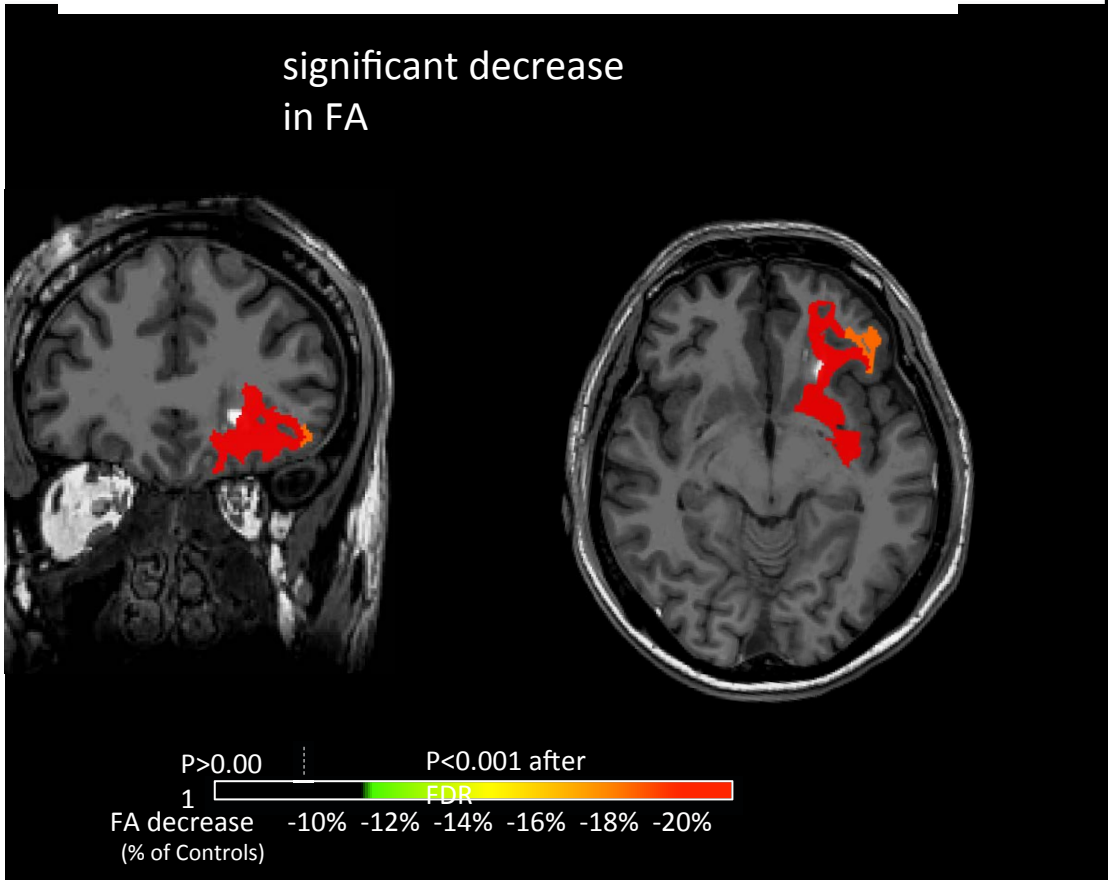


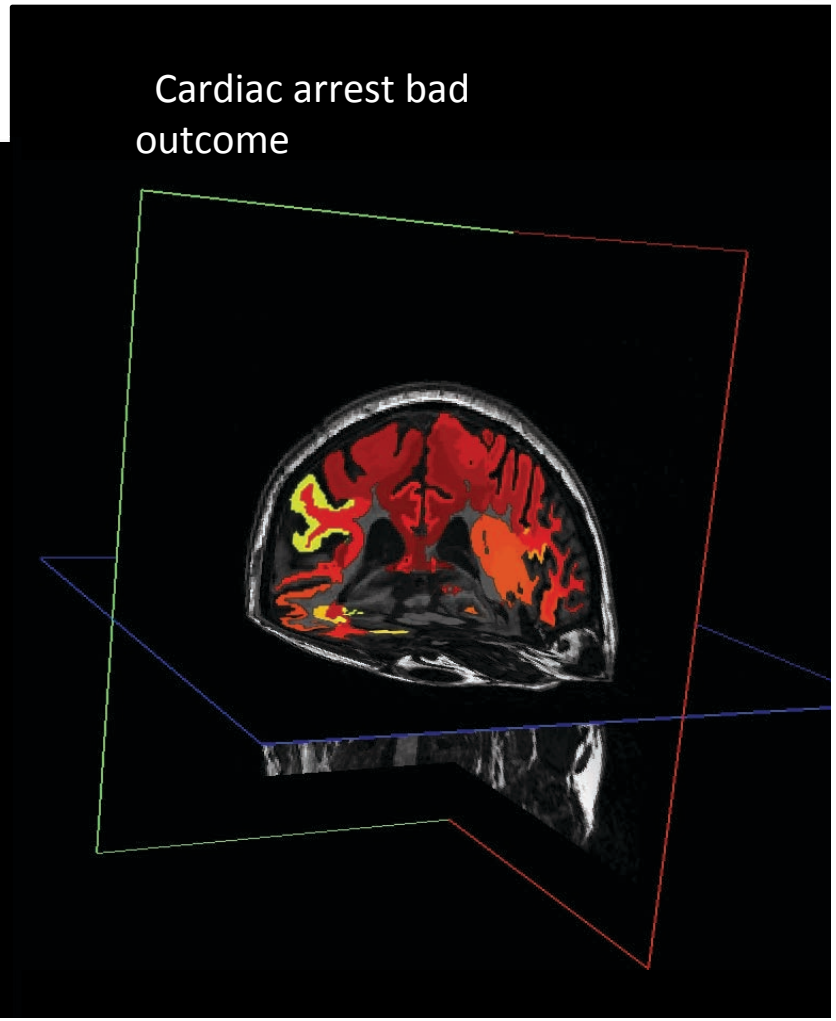
IRM multimodale & anoxie



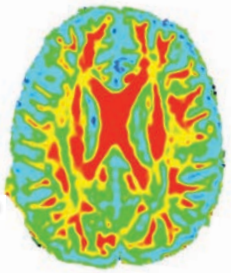
Le DWI à la Pitié Salpêtrière

Results express in % of controls

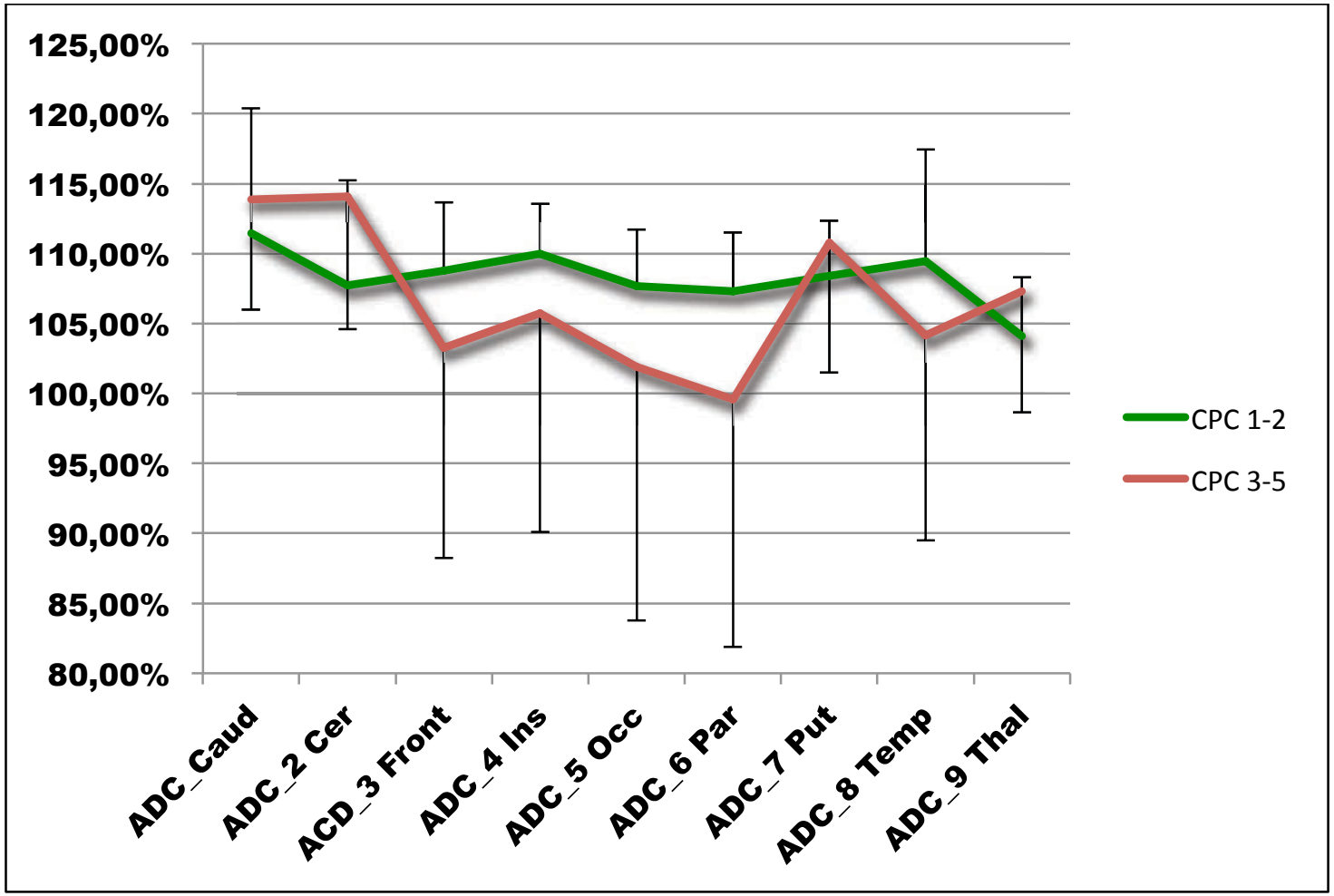




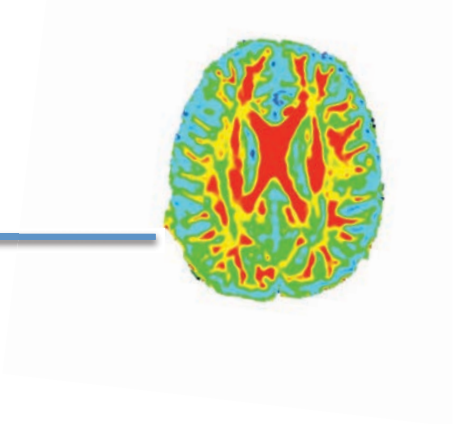
IRM multimodale & anoxie



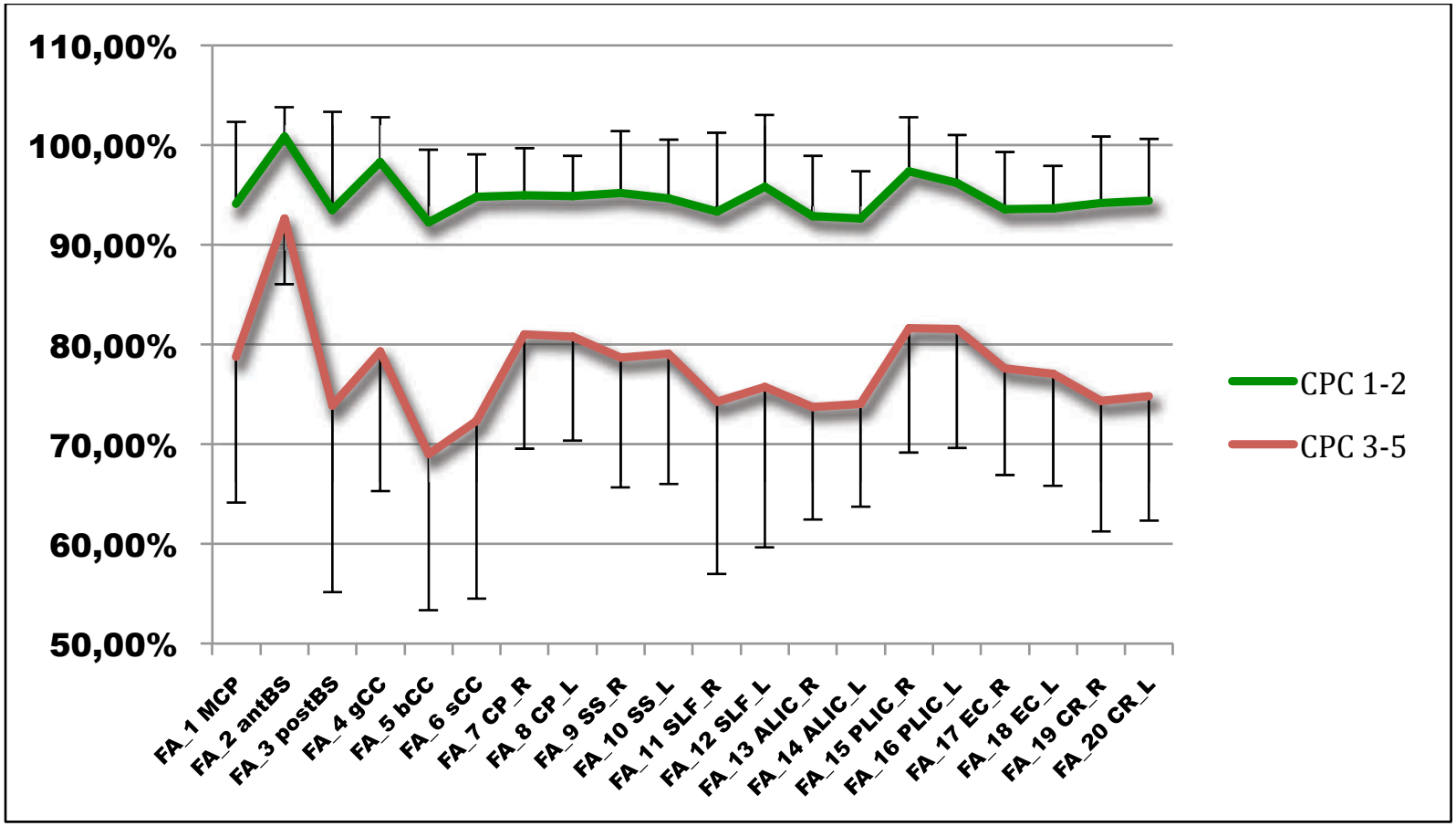
Le DWI à la Pitié Salpêtrière: GM-ADC



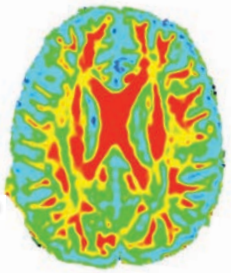
IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière : WM-FA



IRM multimodale & anoxie

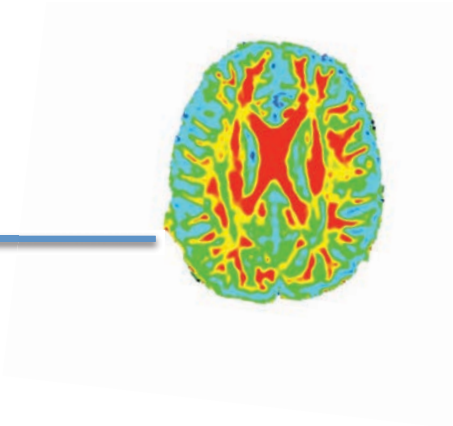


Le DWI à la Pitié Salpêtrière : WM-FA

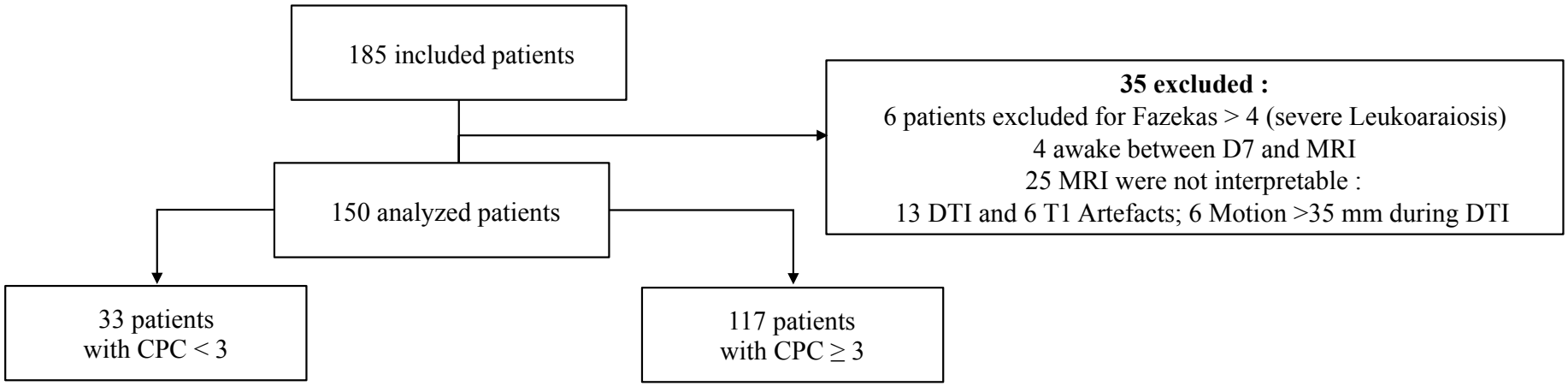
Early Brain Diffusion Tensor Imaging Predicts Long Term Outcome in Patients after Cardiac Arrest

Lionel Velly, M.D., Ph.D., Vincent Perlbarg, Ph.D., Thomas Boulier, Ph.D., Nicolas Adam, M.D., Charles-Edouard Luyt, M.D., Ph.D., Sebastien Delphine M.Eng., Charlotte Arbelot, M.D., Russel Chabanne, M.D., Betty Jean M.D., Carol Di Perri, M.D., Ph.D., Steven Laureys, M.D., Ph.D., Giuseppe Citerio, M.D., Ph.D., Alessia Vargiolu, Ph.D., Benjamin Rohaut M.D., Nicolas Bruder, M.D., Nadine Girard, M.D., Stein Silva, M.D., Ph.D., Jean-Albert Lotterie, M.D., Vincent Cottenceau, M.D., Thomas Tourdias M.D., Ph.D., Olivier Coulon, Ph.D., Bruno Riou, MD., Ph.D., Rajiv Gupta, M.D., Ph.D., Habib Benali, Ph.D., Damien Galanaud, M.D., Ph.D., Louis Puybasset, M.D., Ph.D., for the MRI-COMA Investigators*

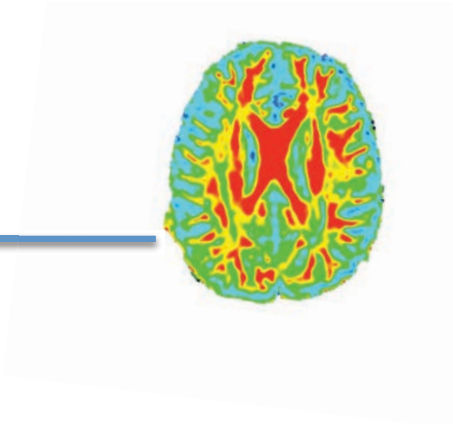
IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière : WM-FA

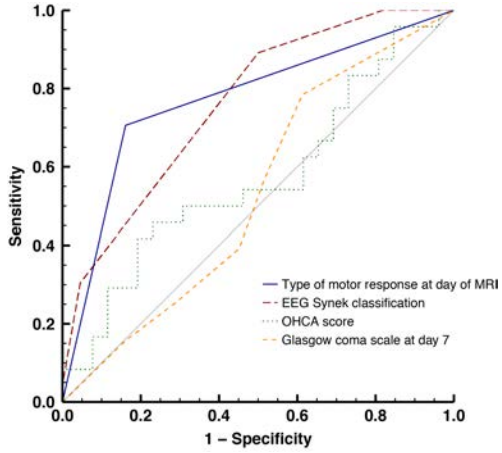


IRM multimodale & anoxie

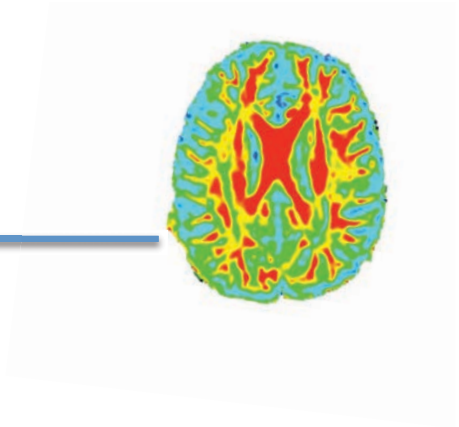


Le DWI à la Pitié Salpêtrière : WM-FA

A Clinical and paraclinical parameters

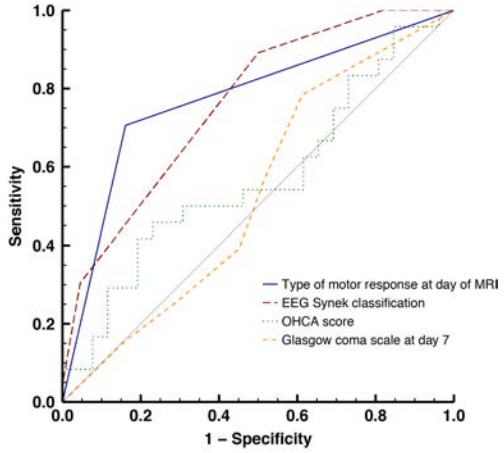


IRM multimodale & anoxie



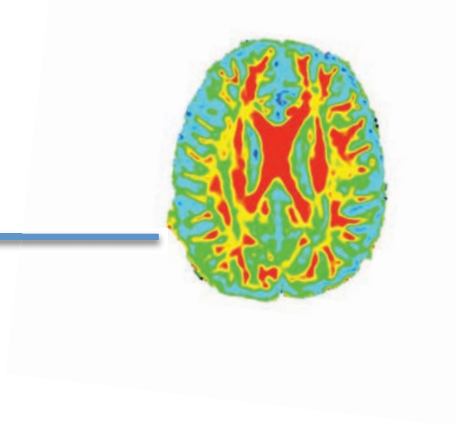
Le DWI à la Pitié Salpêtrière : WM-FA

A Clinical and paraclinical parameters



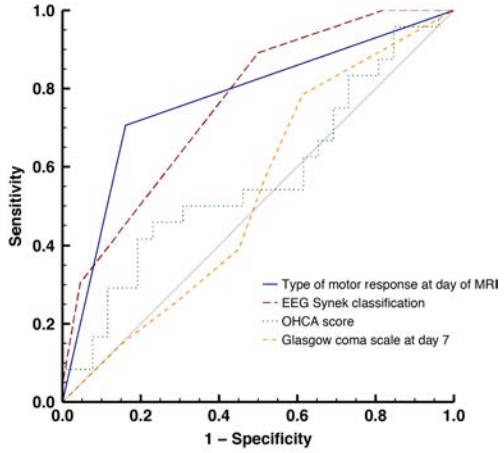
Variables	ROC_{AUC} *(95% confidence interval)*	Optimal Cutoff	Specificity	Sensitivity	Predictive Positive Value	Negative Predictive Value
			Expressed in percent (95% confidence interval)			
Clinical, biological and electroencephalography (EEG) variables						
OHCA score	0.62 (0.50–0.75) †	≥58	100 (87–100)	6 (2–15) ‡	100 (40–100)	31 (22–42)
EEG Synek classification	0.74 (0.64–0.85) †	≥5	100 (86–100)	5 (2–11) ‡	100 (48–100)	20 (13–28)

IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière : WM-FA

A Clinical and paraclinical parameters



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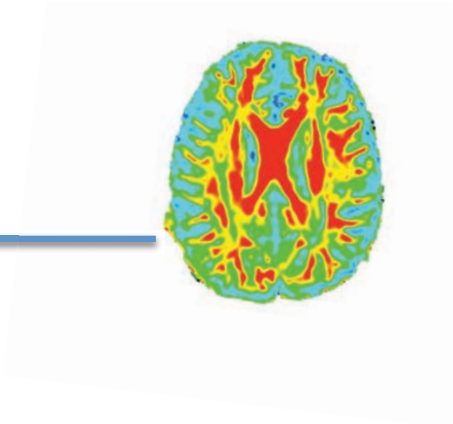
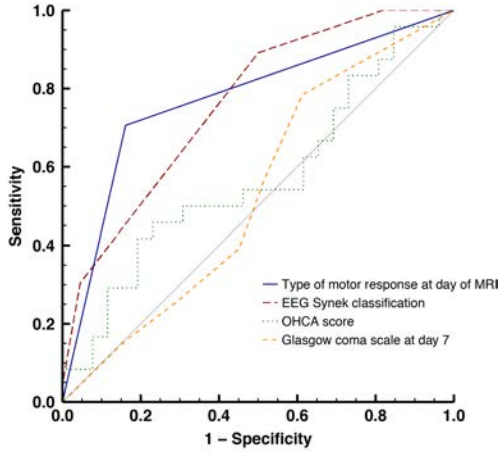
IRM multimodale & anoxie

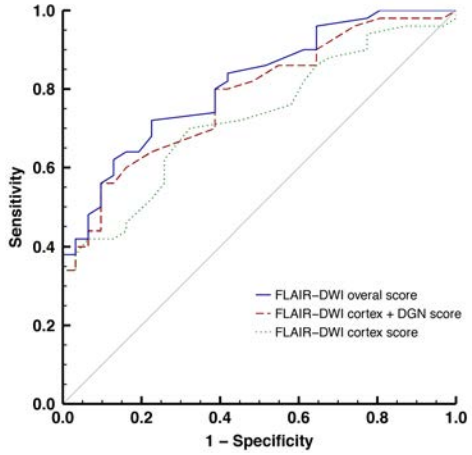


Le DWI à la Pitié Salpêtrière : WM-FA

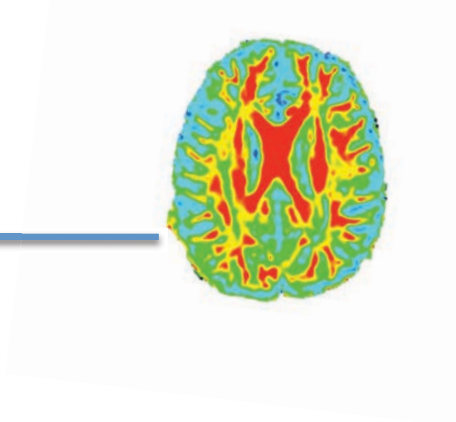
A Clinical and paraclinical parameters



B Qualitative MRI

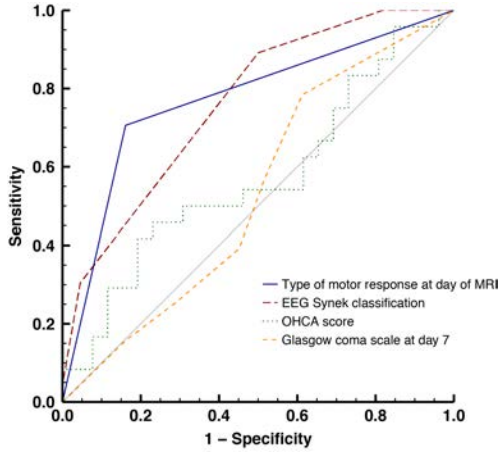


IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière : WM-FA

A Clinical and paraclinical parameters



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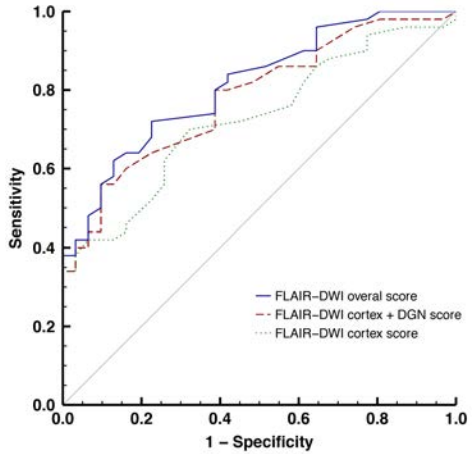

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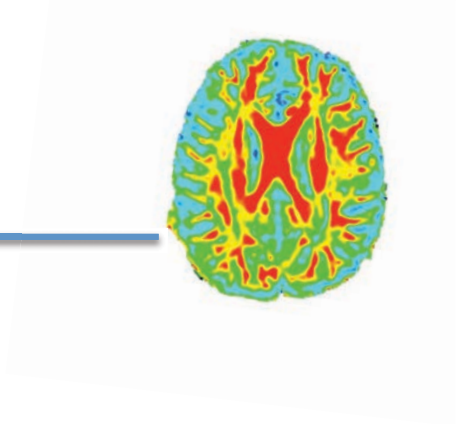
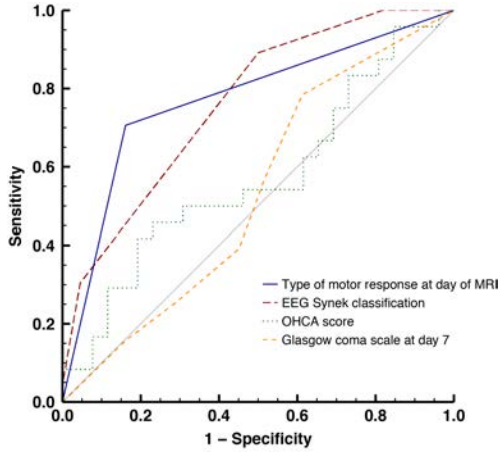
			Expressed in percent (95% confidence interval)			
Qualitative Magnetic Resonance Imaging (MRI) variables						
FLAIR-DWI "overall" score	0.83 (0.76–0.90) †	≥41	100 (89–100)	40 (31–50) ‡	100 (92–100)	32 (23–42)
FLAIR-DWI "cortex" score	0.75 (0.67–0.83) †	≥30	100 (89–100)	33 (25–42) ‡	100 (91–100)	30 (22–39)
FLAIR-DWI "cortex + deep gray nuclei" score	0.81 (0.74–0.88) †	≥41	100 (89–100)	37 (28–46) ‡	100 (92–100)	31 (22–41)

IRM multimodale & anoxie



Le DWI à la Pitié Salpêtrière : WM-FA

A Clinical and paraclinical parameters



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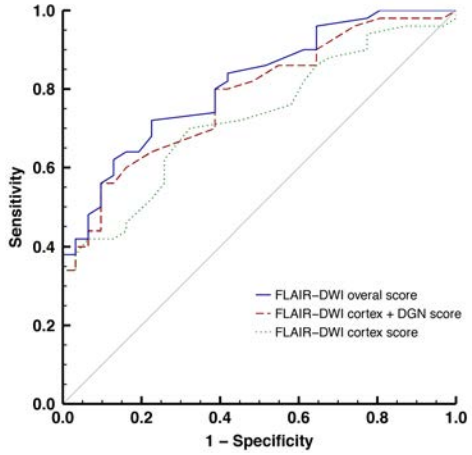

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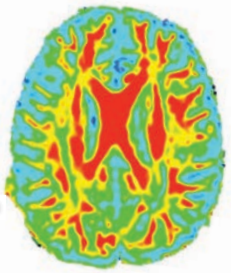
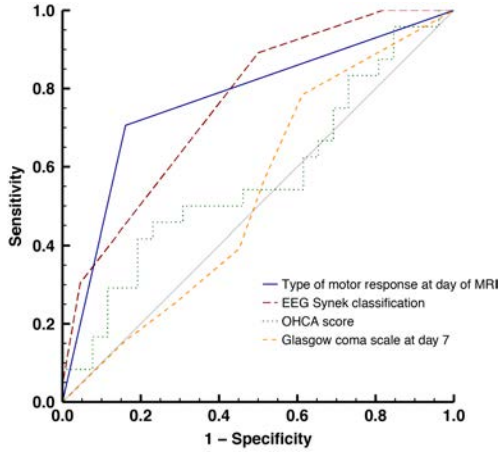
FLAIR-DWI "cortex + deep gray nuclei" score	0.81 (0.74–0.88) †	≥41	100 (89–100)	37 (28–46) ‡	100 (92–100)	31 (22–41)

IRM multimodale & anoxie

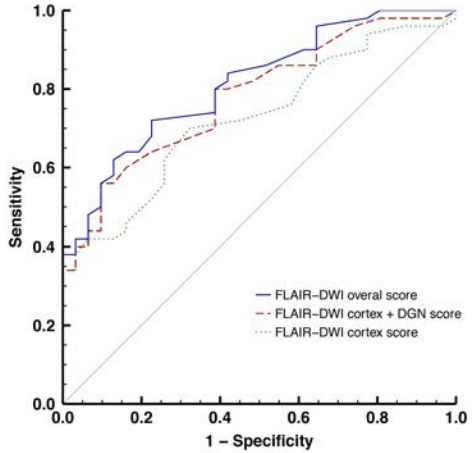


Le DWI à la Pitié Salpêtrière : WM-FA

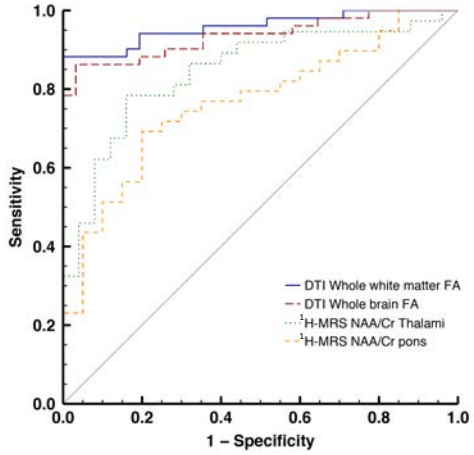
A Clinical and paraclinical parameters



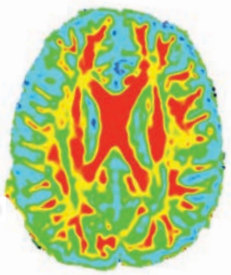
B Qualitative MRI



C Quantitative MRI

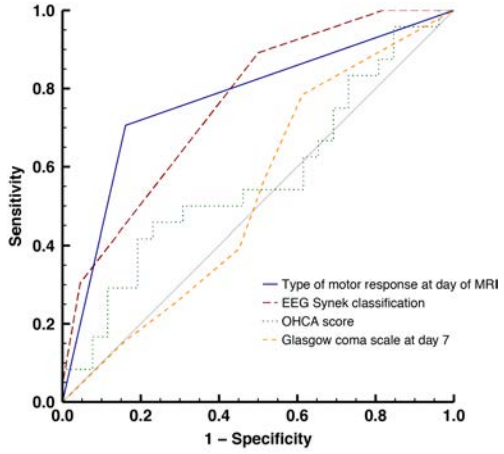


IRM multimodale & anoxie

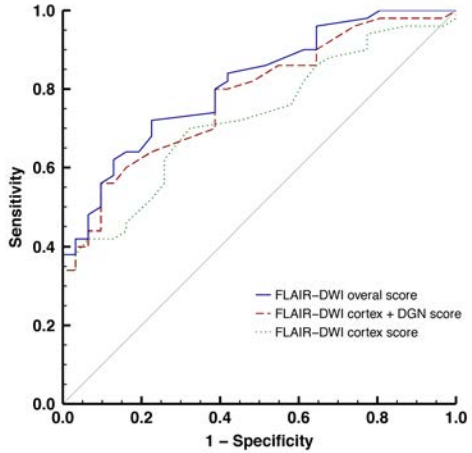


Le DWI à la Pitié Salpêtrière : WM-FA

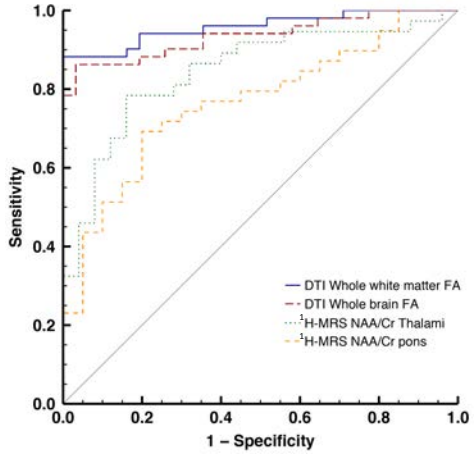
A Clinical and paraclinical parameters



B Qualitative MRI

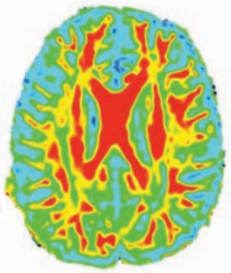


C Quantitative MRI



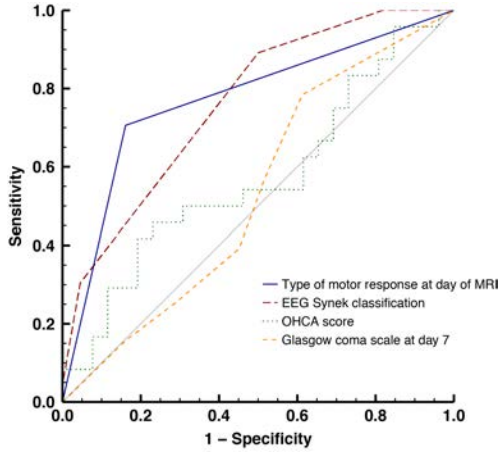
Variables	ROC_{AUC} *(95% confidence interval)*	Optimal Cutoff	Specificity	Sensitivity	Predictive Positive Value	Negative Predictive Value
			Expressed in percent (95% confidence interval)			
Quantitative MRI variables						
Whole white matter FA	0.95 (0.91–0.98)	<91%	100 (89–100)	89 (82–94)	100 (96–100)	72 (57–84)
Whole brain FA	0.92 (0.88–0.96)	<91%	100 (89–100)	80 (72–87)	100 (96–100)	59 (45–72)
NAA/Cr Thalami	0.85 (0.77–0.93) †	<0.9	100 (87–100)	30 (21–40) ‡	100 (88–100)	29 (20–39)
NAA/Cr Pons	0.78 (0.68–0.87) †	<1.6	100 (85–100)	29 (20–39) ‡	100 (88–100)	24 (16–35)

IRM multimodale & anoxie

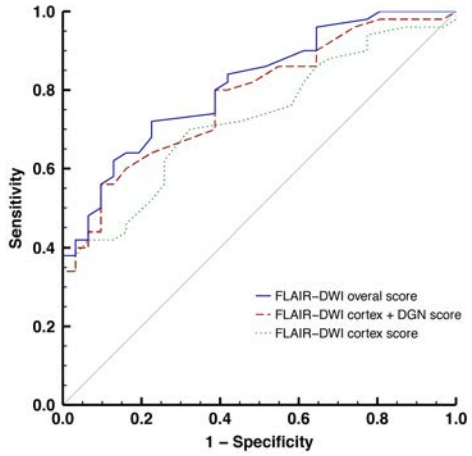


Le DWI à la Pitié Salpêtrière : WM-FA

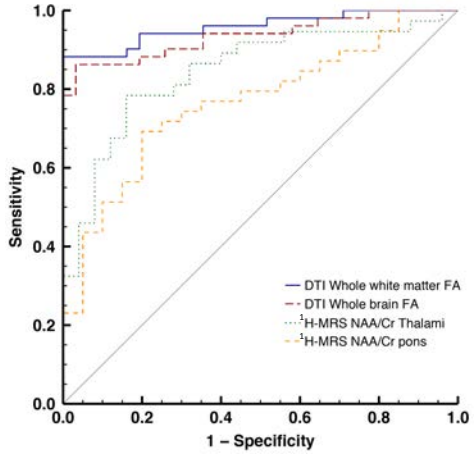
A Clinical and paraclinical parameters



B Qualitative MRI

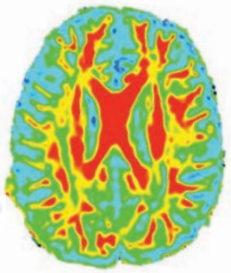


C Quantitative MRI



Variables	ROC_{AUC} *(95% confidence interval)*	Optimal Cutoff	Specificity	Sensitivity	Predictive Positive Value	Negative Predictive Value
			Expressed in percent (95% confidence interval)			
Quantitative MRI variables						
Whole white matter FA	0.95 (0.91–0.98)	<91%	100 (89–100)	89 (82–94)	100 (96–100)	72 (57–84)
Whole brain FA	0.92 (0.88–0.96)	<91%	100 (89–100)	80 (72–87)	100 (96–100)	59 (45–72)
NAA/Cr Thalami	0.85 (0.77–0.93) †	<0.9	100 (87–100)	30 (21–40) ‡	100 (88–100)	29 (20–39)
NAA/Cr Pons	0.78 (0.68–0.87) †	<1.6	100 (85–100)	29 (20–39) ‡	100 (88–100)	24 (16–35)

IRM multimodale & anoxie

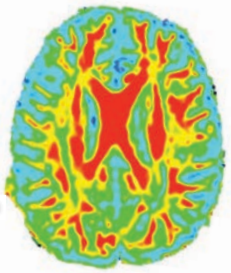


Le DWI à la Pitié Salpêtrière : WM-FA

Table S5. Prognostic Values of Significant Variables of the Patients Without a Limitation or Withdrawal of Care Decision*

Variables	ROC_{AUC} *(95% Confidence Interval)*	Optimal cutoff	Specificity	Sensitivity	Predictive Positive Value	Negative Predictive Value
			Expressed in percent (95% Confidence Interval)			
Clinical, biological and electroencephalography (EEG) variables						
OHCA score	0.57 (0.41–0.74)†	≥58	100 (87–100)	8 (1–27)‡	100 (16–100)	54 (39–69)
EEG Synek classification	0.76 (0.65–0.87)†	≥5	100 (85–100)	4 (1–15)‡	100 (16–100)	33 (22–46)
Qualitative Magnetic Resonance Imaging (MRI) variables						
FLAIR-DWI overall score	0.81 (0.72–0.90)†	≥42	100 (89–100)	38 (25–53)‡	100 (82–100)	50 (37–63)
FLAIR-DWI cortex score	0.73 (0.62–0.84)†	≥30	100 (89–100)	34 (21–49)‡	100 (80–100)	48 (36–61)
FLAIR-DWI cortex + deep gray nuclei score	0.78 (0.68–0.88)†	≥42	100 (89–100)	34 (21–49)‡	100 (80–100)	48 (36–61)
Quantitative MRI variables						
Whole white matter FA	0.96 (0.92–1.00)	<91%	100 (89–100)	88 (76–96)	100 (92–100)	84 (68–94)
Whole brain FA	0.94 (0.88–0.99)	<91%	100 (89–100)	78 (65–89)	100 (91–100)	74 (58–86)
NAA/Cr Thalami	0.85 (0.75–0.94)†	<0.9	100 (86–100)	32 (18–50)‡	100 (74–100)	50 (36–64)
NAA/Cr Pons	0.77 (0.64–0.89)†	<1.6	100 (83–100)	23 (11–39)‡	100 (66–100)	40 (26–55)
Combination of (Multivariate models)						
Standard criteria– OHCA score – EEG Synek classification	0.84 (0.74–0.94)†	-	100 (85–100)	4 (1–15)‡	100 (16–100)	33 (22–46)
Standard criteria – OHCA score – EEG Synek classification – qualitative MRI	0.84 (0.75–0.93)†	-	100 (85–100)	62 (47–76)‡	100 (88–100)	56 (40–72)
Standard criteria – OHCA score – EEG Synek classification – qualitative MRI – quantitative MRI	0.99 (0.98–1.00)	-	100 (85–100)	93 (82–99)	100 (92–100)	88 (69–97)

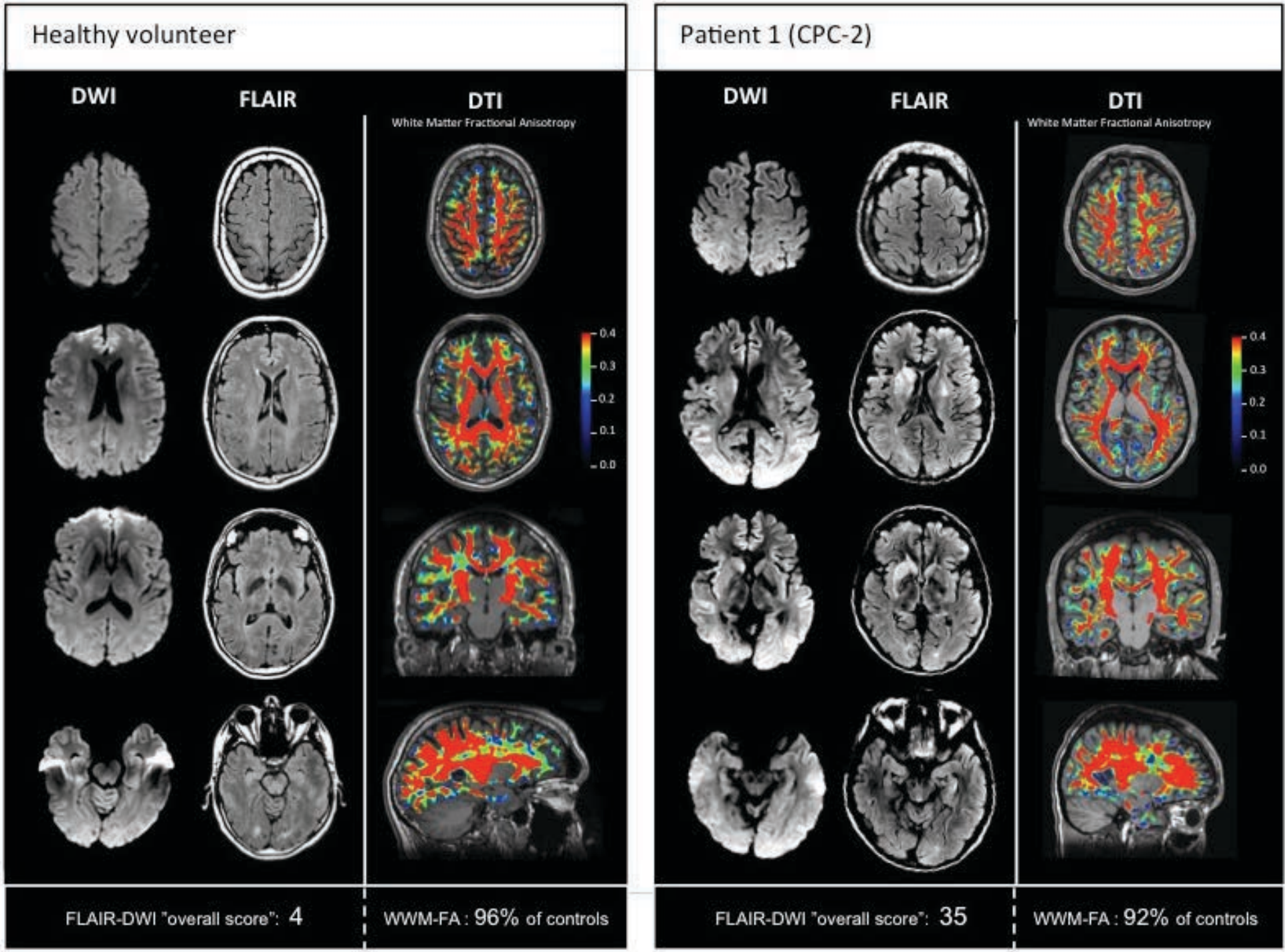
IRM multimodale & anoxie

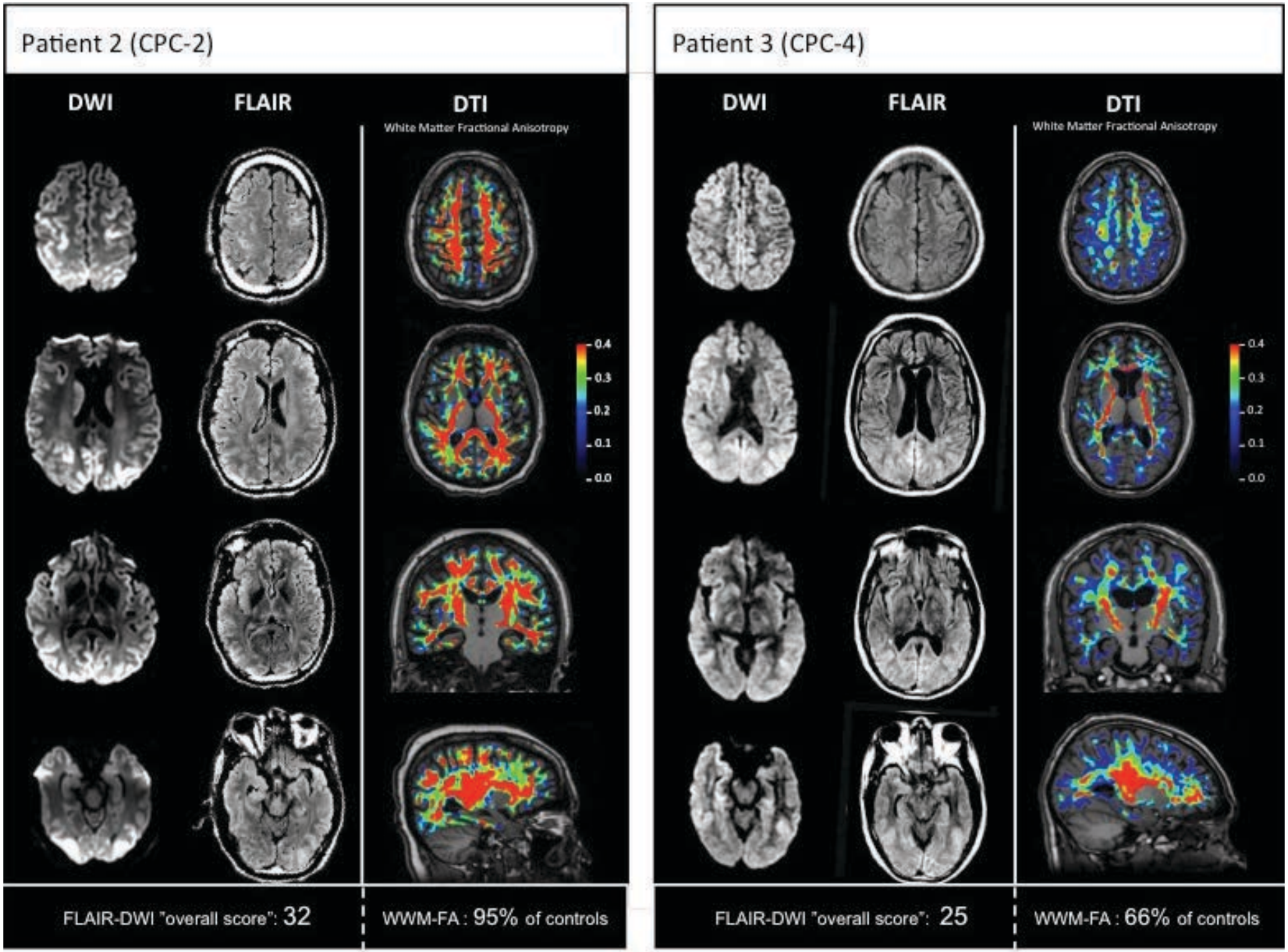


Le DWI à la Pitié Salpêtrière : WM-FA

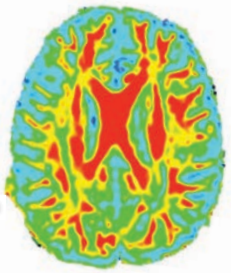
RESULTS

In total, 185 patients were enrolled and 150 had an interpretable multimodal MRI. Thirty-three patients (22%) had a good neurologic outcome. Prognostic accuracy, as quantified by the area under the receiver operating characteristic curve (ROC_{AUC}), was significantly higher with the normalized WWM-FA value (ROC_{AUC} 0.95; 95% confidence interval (CI) 0.91 to 0.98) than with the standard criteria for poor outcome or other MRI sequences. The probability of good outcome with a WWM-FA value of >95% was 95% (95% CI 87 to 100).

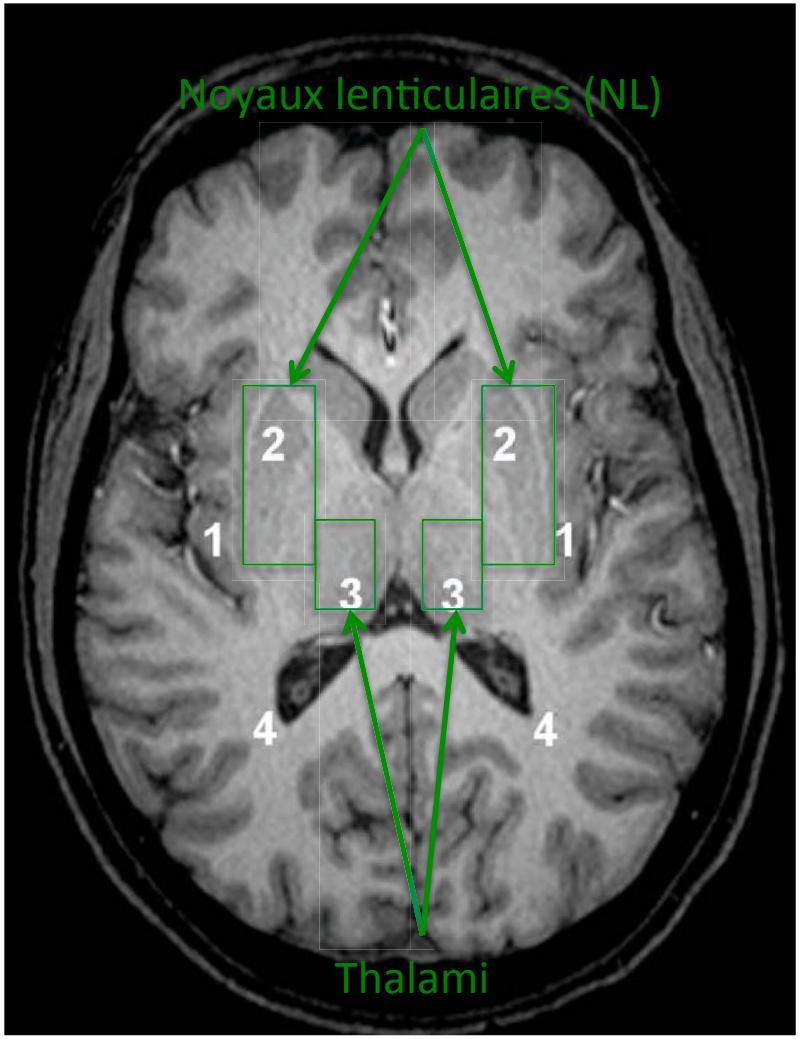

Healthy volunteer
DWI
FLAIR
DTI
White Matter Fractional Anisotropy
0.4
0.3
0.2
0.1
0.0
FLAIR-DWI "overall score": 4
WWM-FA : 96% of controls
Patient 1 (CPC-2)
DWI
FLAIR
DTI
White Matter Fractional Anisotropy
0.4
0.3
0.2
0.1
0.0
FLAIR-DWI "overall score": 35
WWM-FA : 92% of controls

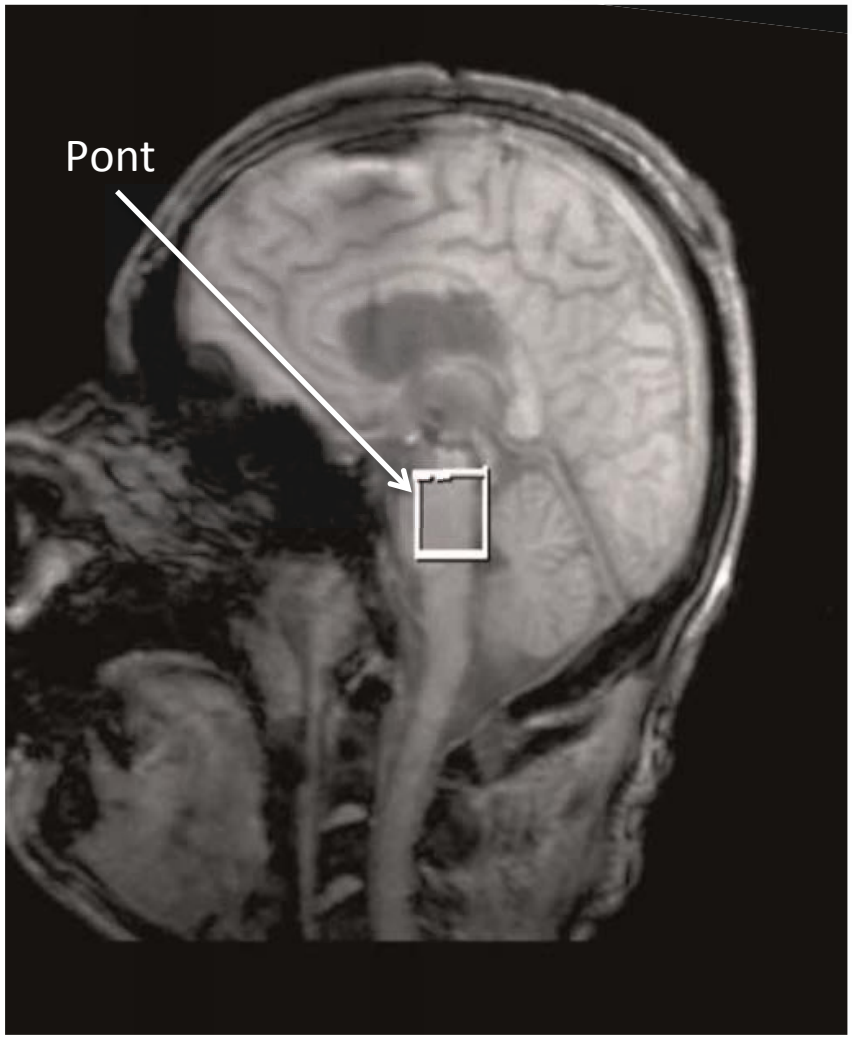

Patient 2 (CPC-2)
DWI
FLAIR
DTI
White Matter Fractional Anisotropy
0.4
0.3
0.2
0.1
0.0
FLAIR-DWI "overall score": 32
WWM-FA : 95% of controls
Patient 3 (CPC-4)
DWI
FLAIR
DTI
White Matter Fractional Anisotropy
0.4
0.3
0.2
0.1
0.0
FLAIR-DWI "overall score": 25
WWM-FA : 66% of controls

IRM multimodale & anoxie

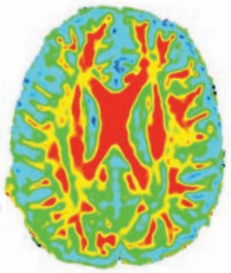


La SRM

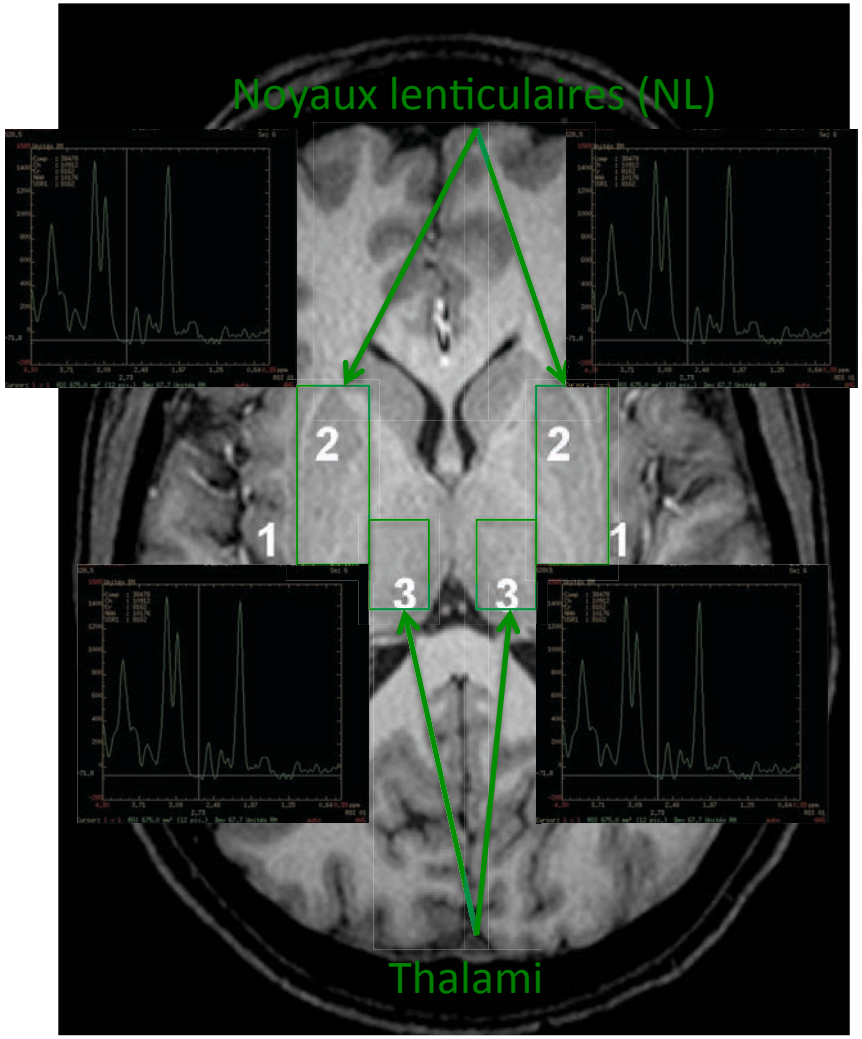


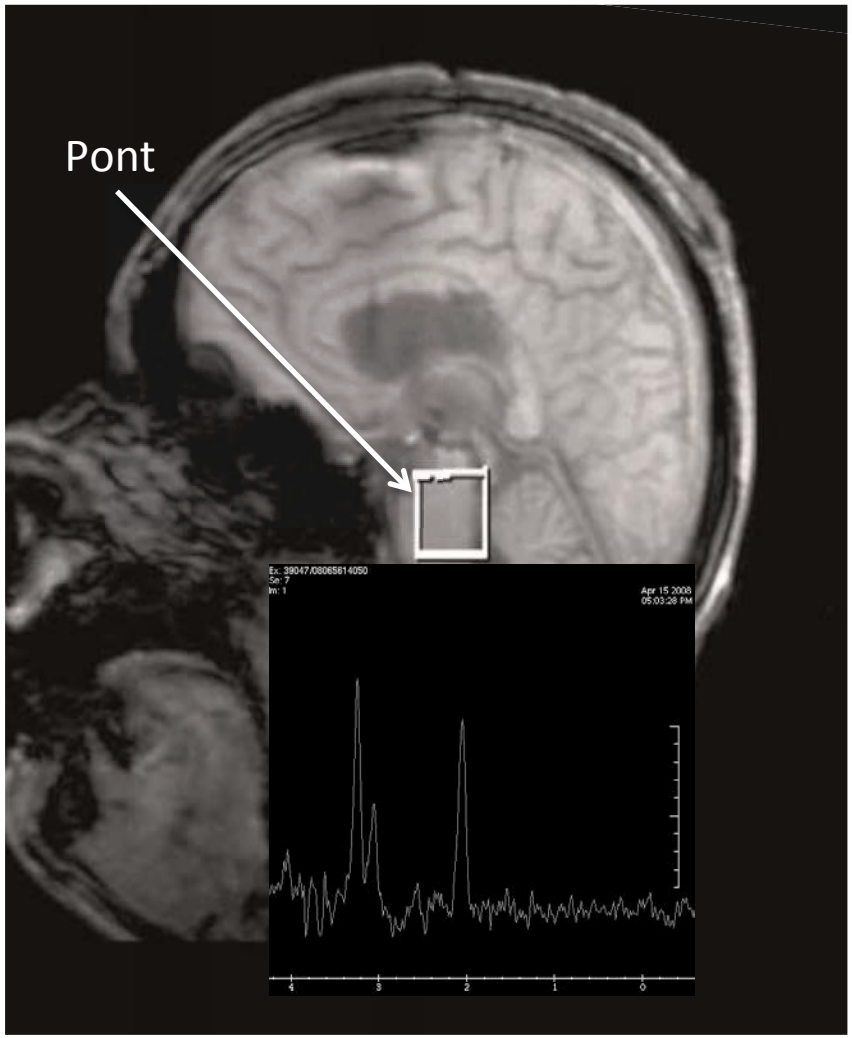


IRM multimodale & anoxie

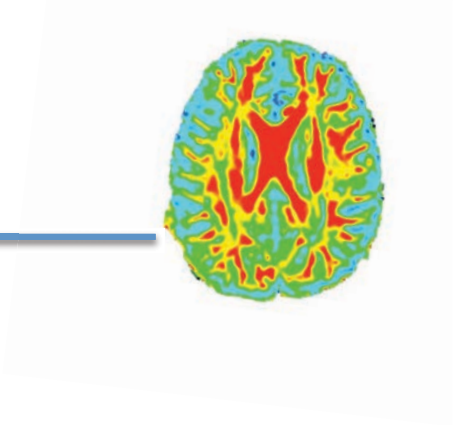


La SRM

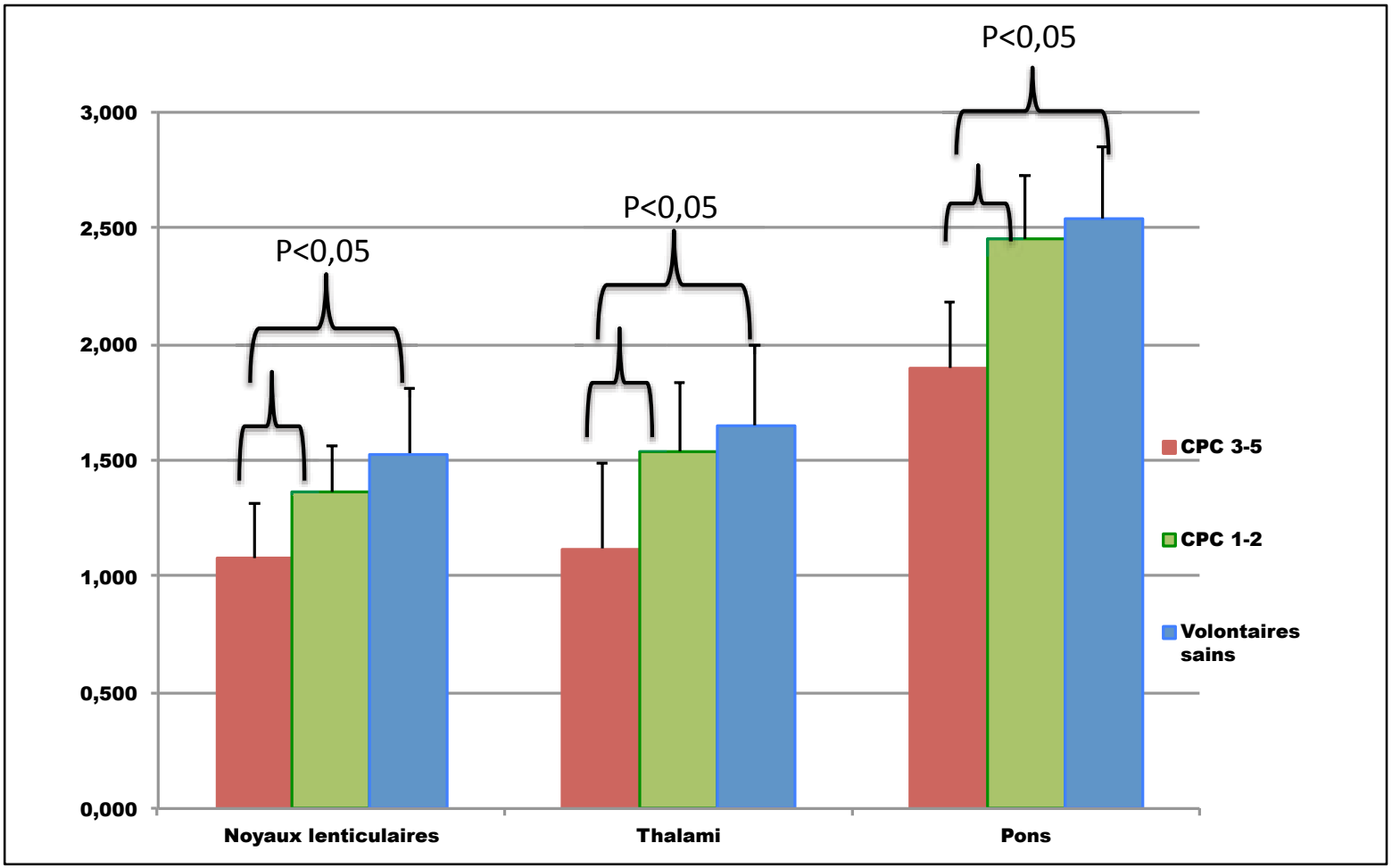




IRM multimodale & anoxie



La SRM



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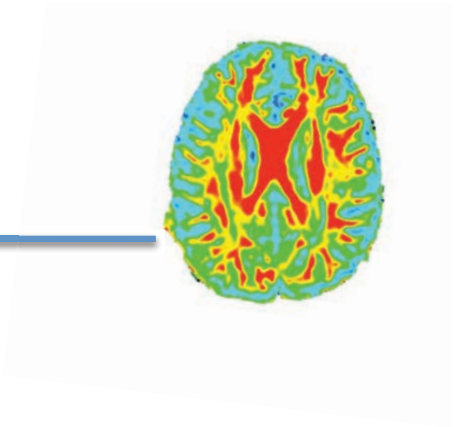
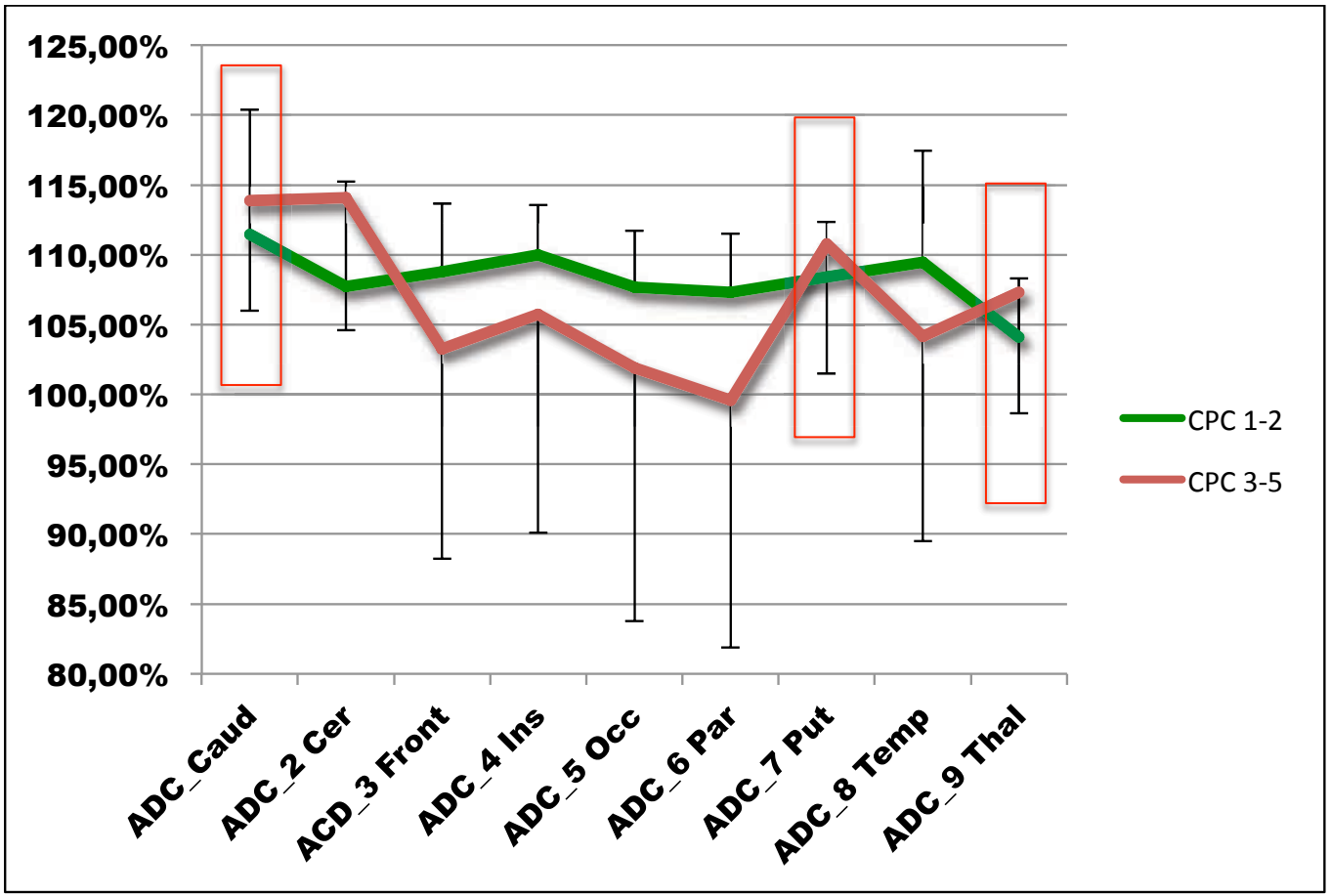
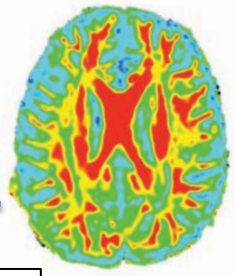


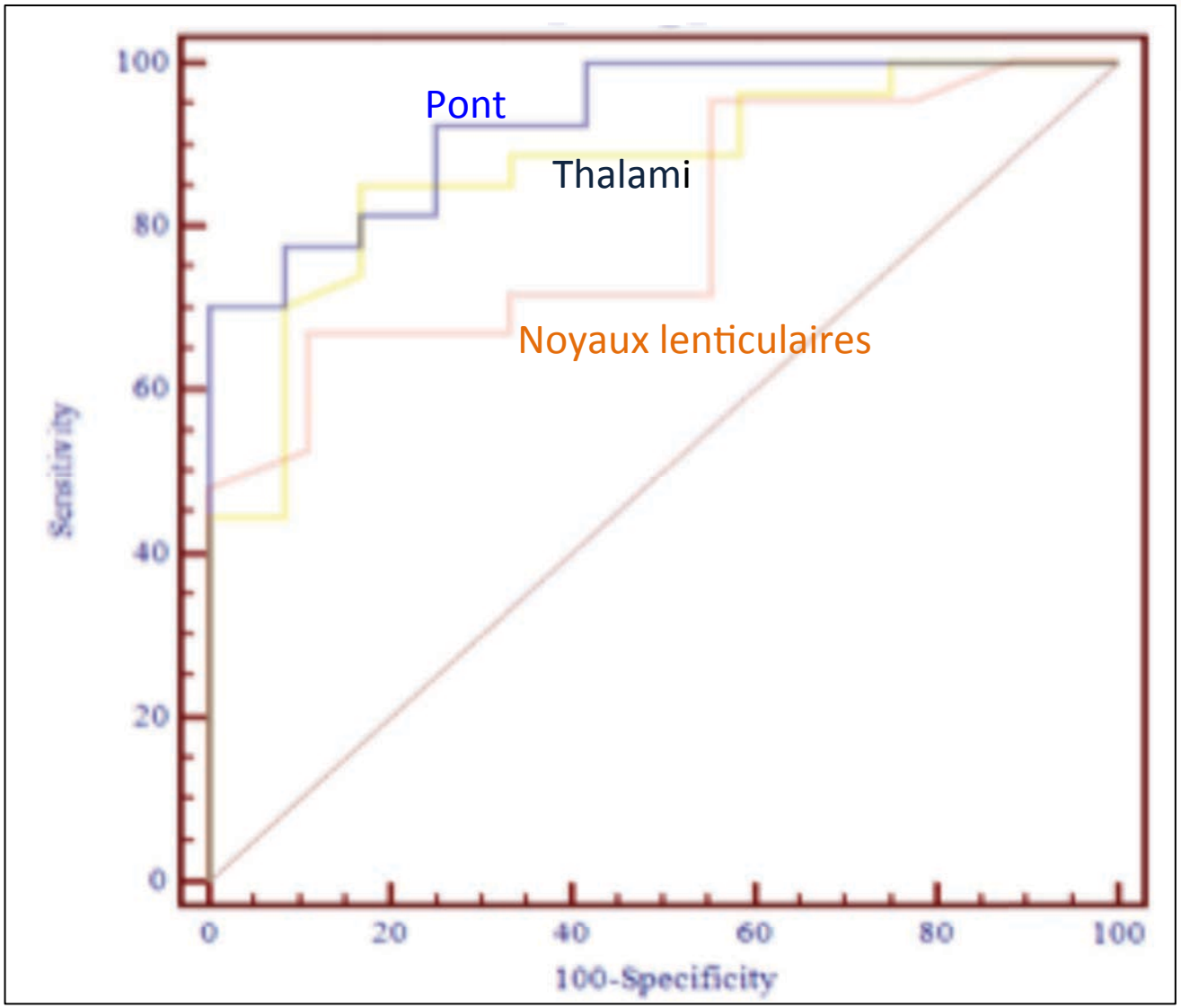
La SRM



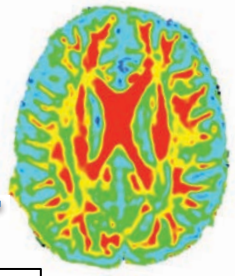
IRM multimodale & anoxie



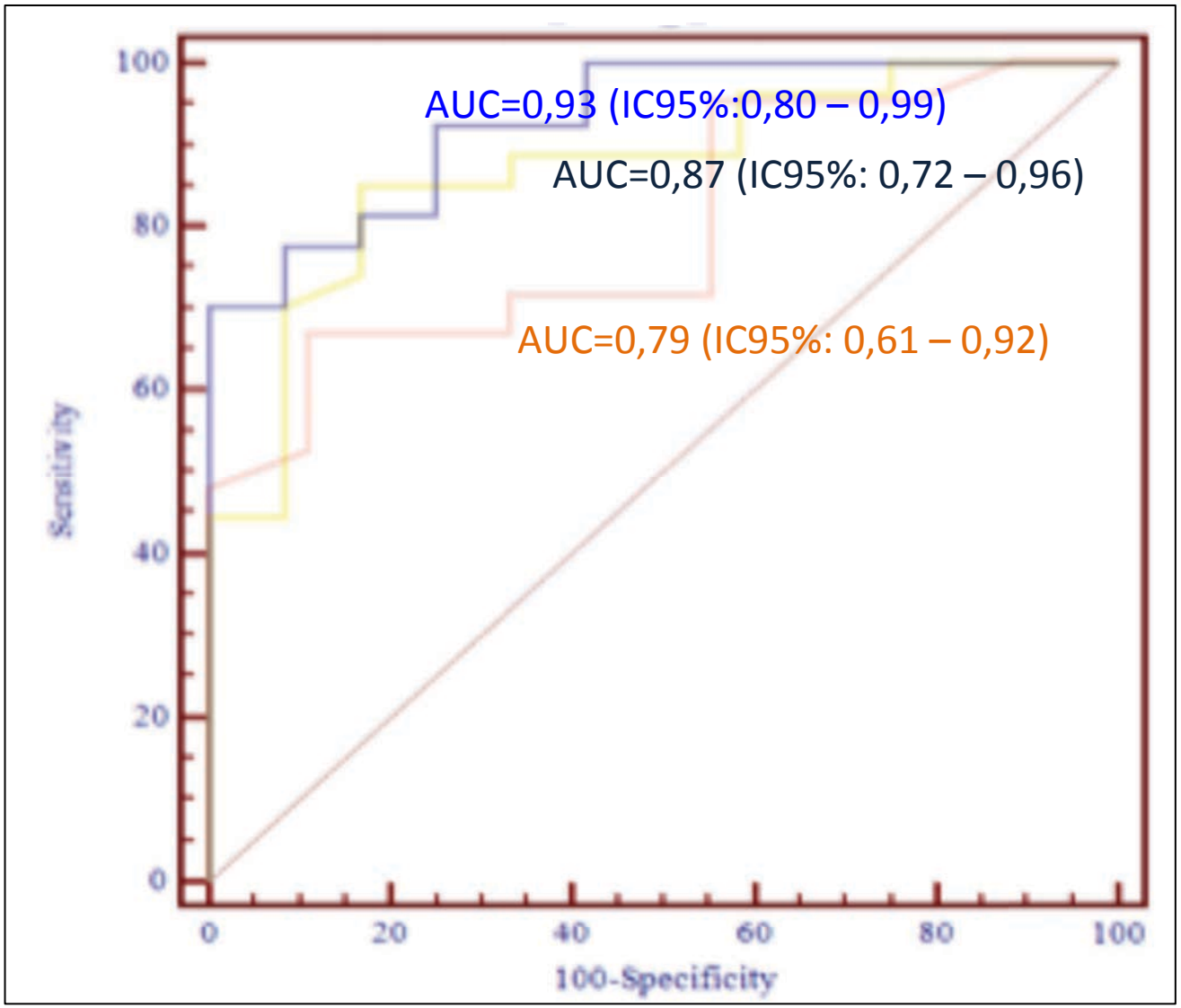
La SRM



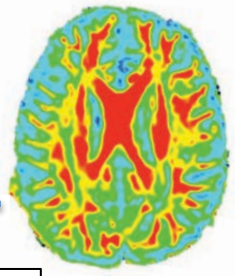
IRM multimodale & anoxie



La SRM



IRM multimodale & anoxie

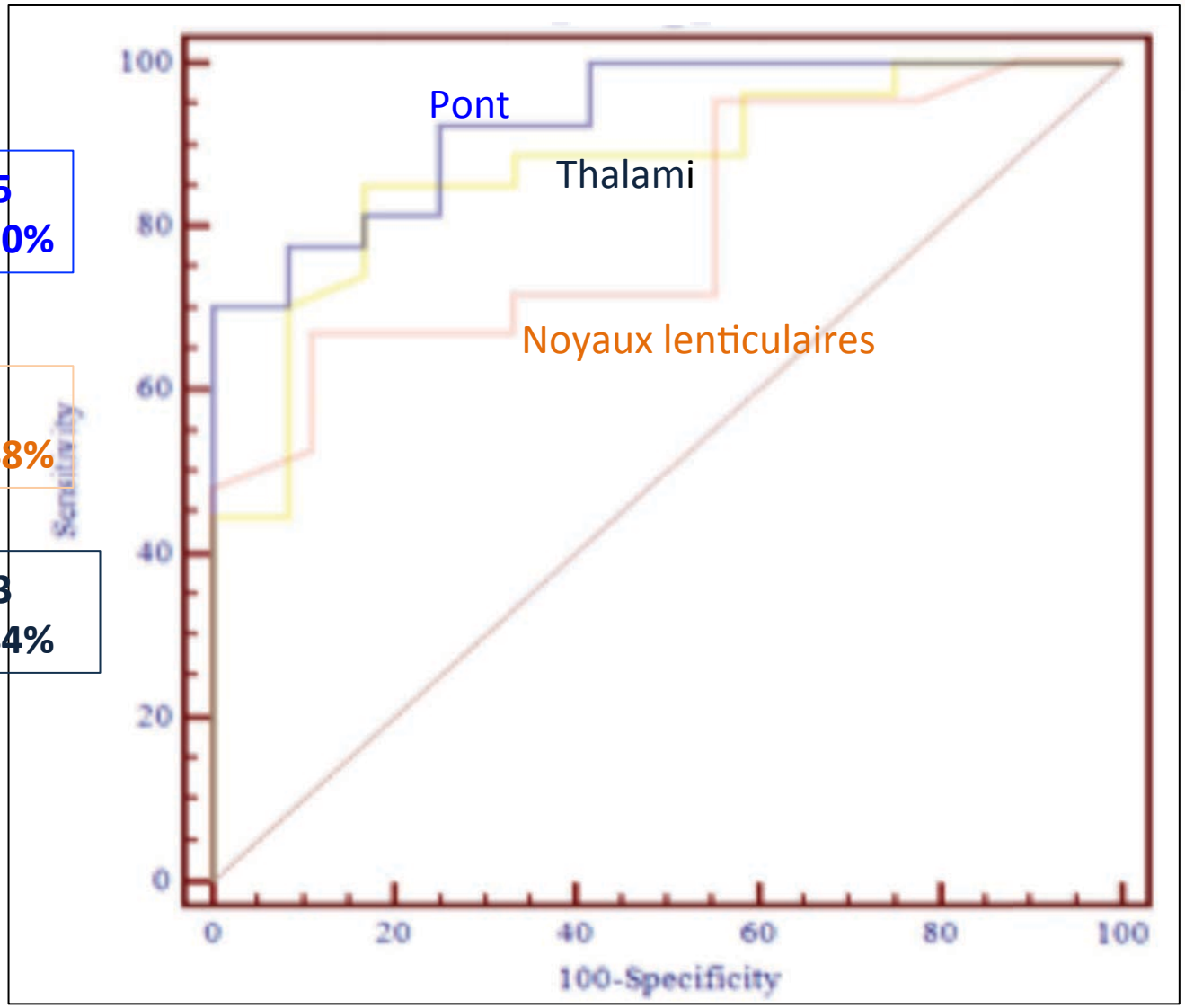


La SRM

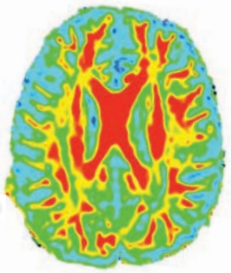
NAA/Cr <2,05
Sp 100% Se 70%

NAA/Cr<1,1
Sp 100% Se 48%

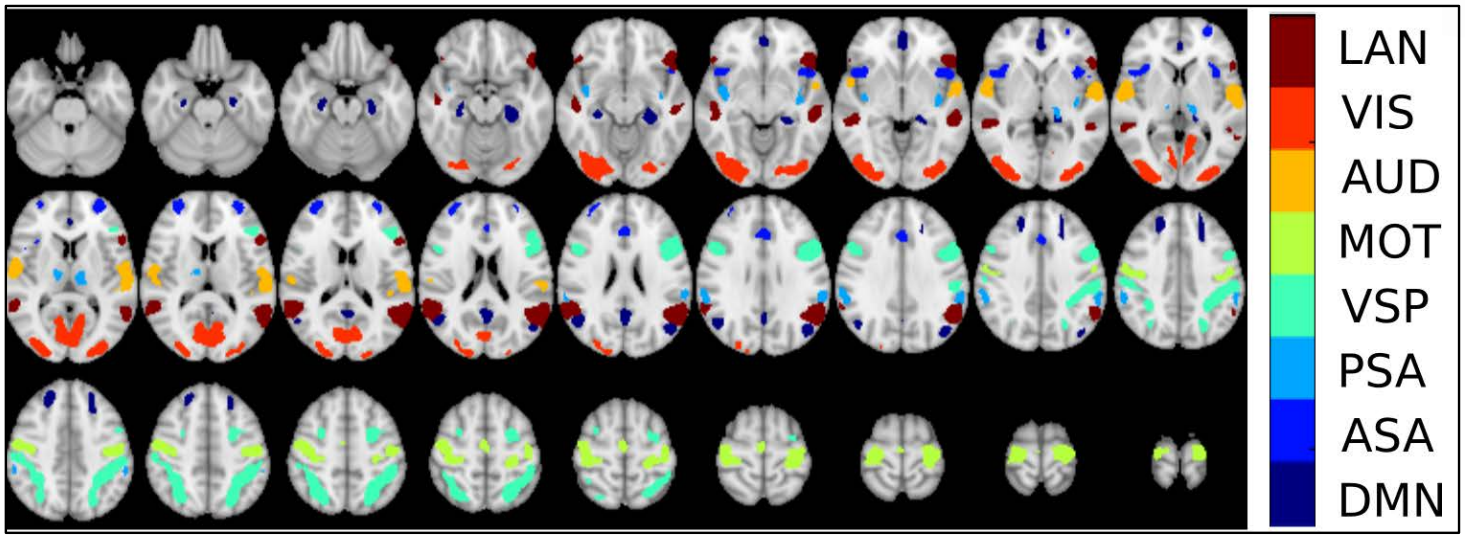
NAA/Cr<0 ,93
Sp 100% Se 44%



IRM multimodale & anoxie

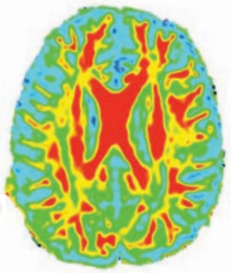


L'IRM fonctionnelle à la Pitié

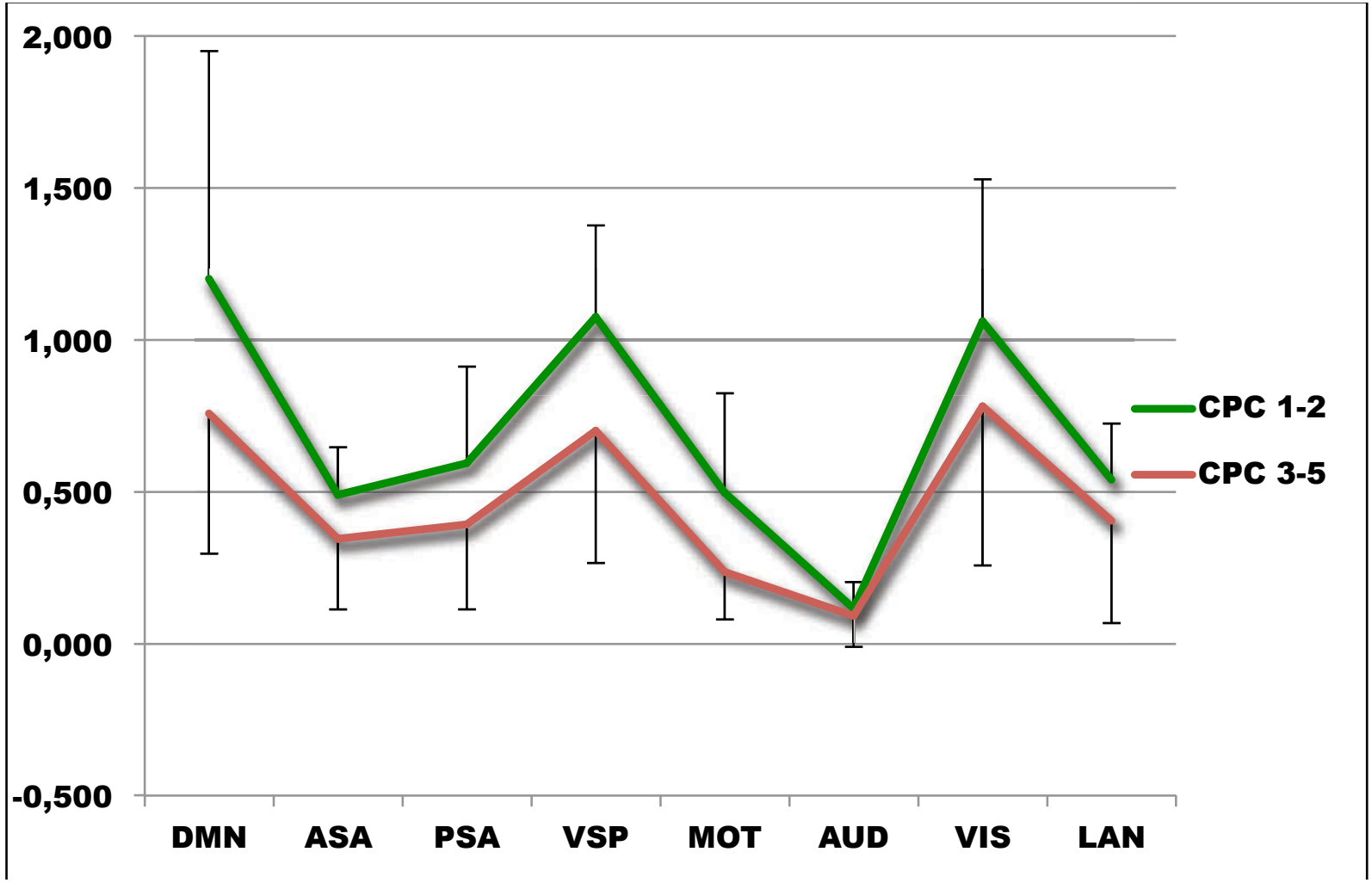


1) Intégration DMN: intégration dans le réseau par défaut
2) Intégration ASA: intégration dans le réseau antérieur de la salience
3) Intégration PSA: intégration dans le réseau postérieur de la salience
4) Intégration VSP: intégration dans le réseau de l'attention visio-spatiale
5) Intégration MOT: intégration dans le réseau moteur
6) Intégration AUD: intégration dans le réseau auditif
7) Intégration VIS: intégration dans le réseau visuel
8) Intégration LAN: intégration dans le réseau du langage

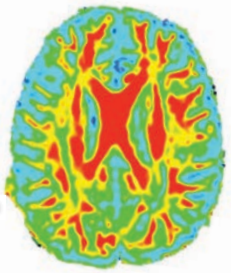
IRM multimodale & anoxie



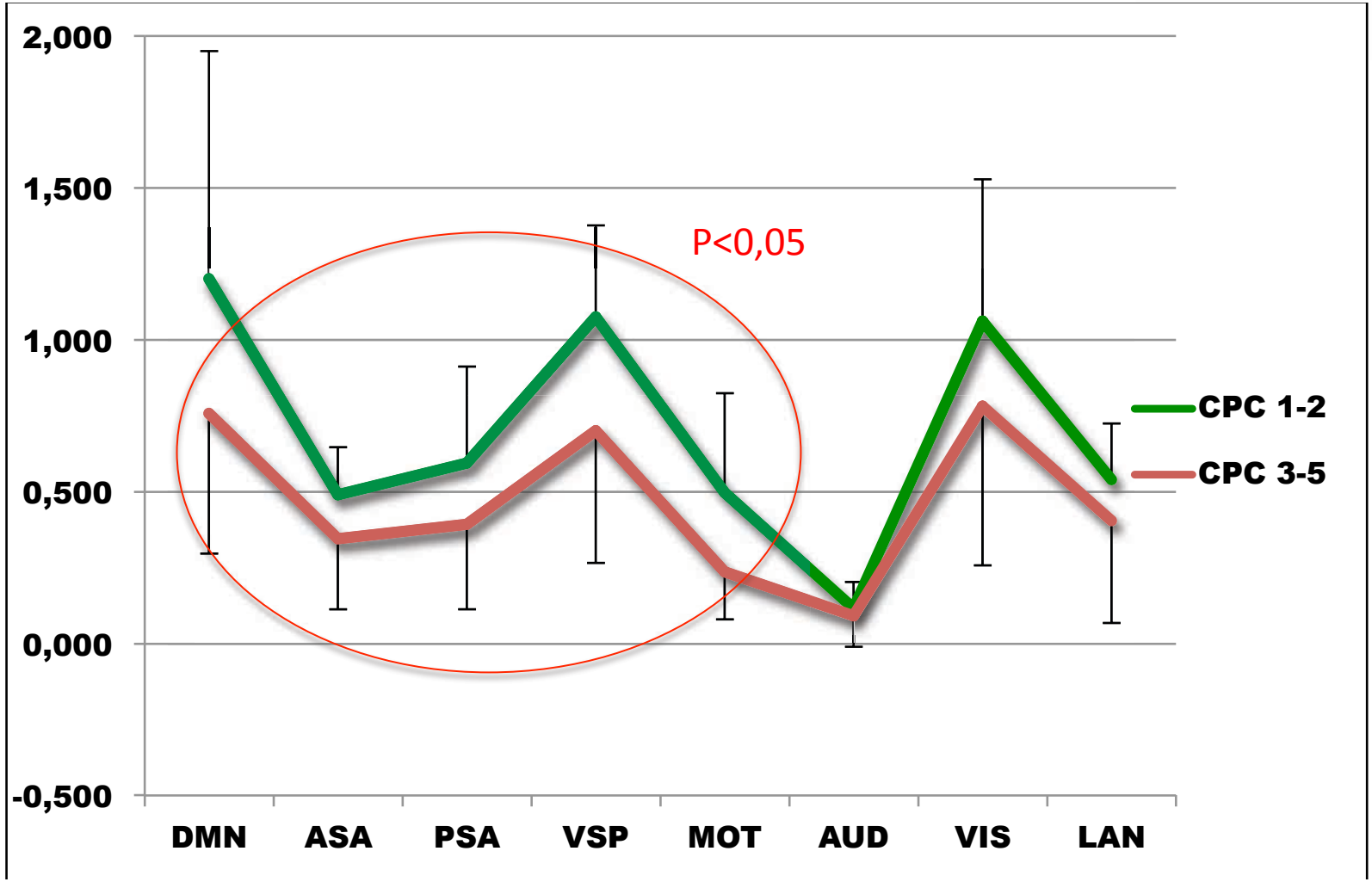
L'IRM fonctionnelle à la Pitié



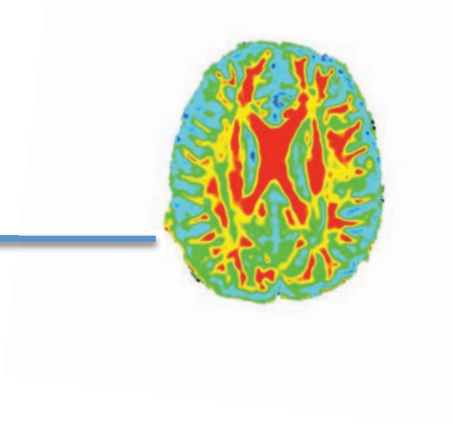
IRM multimodale & anoxie



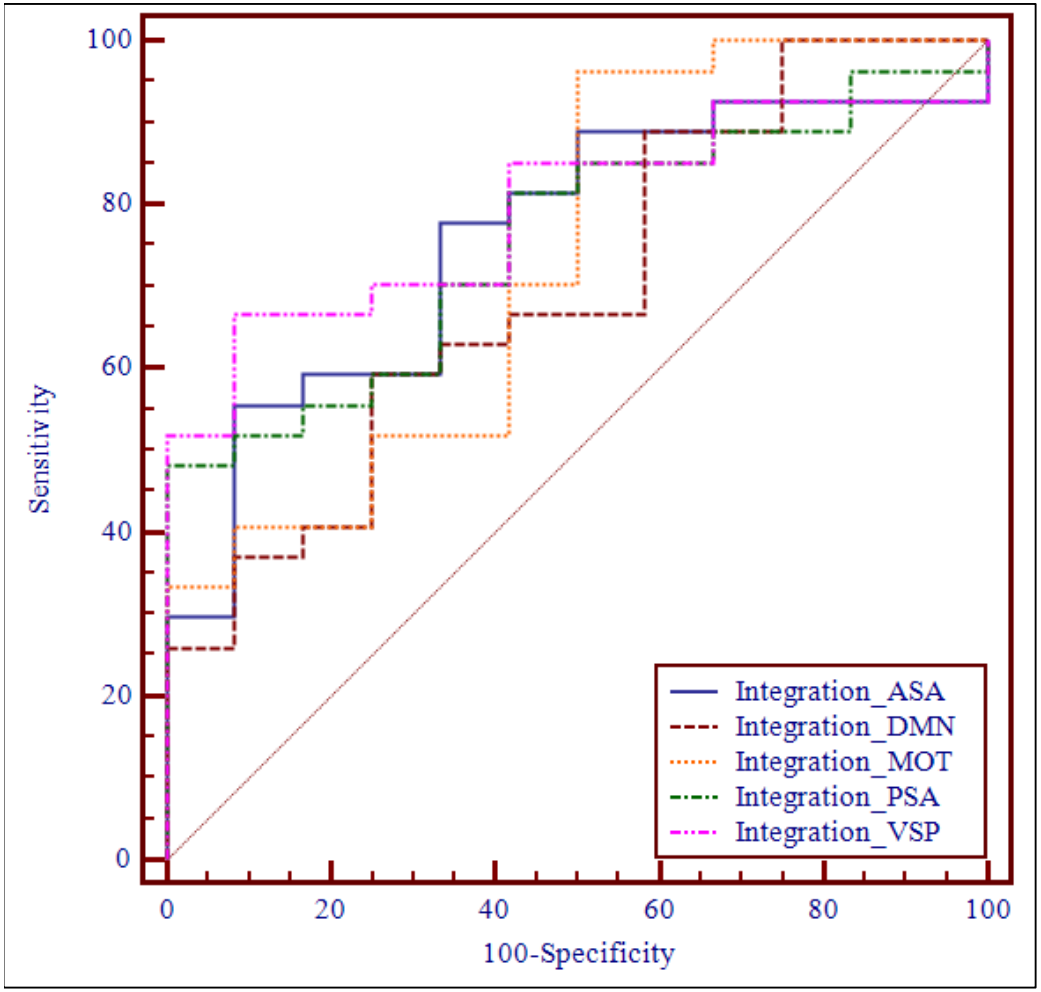
L'IRM fonctionnelle à la Pitié



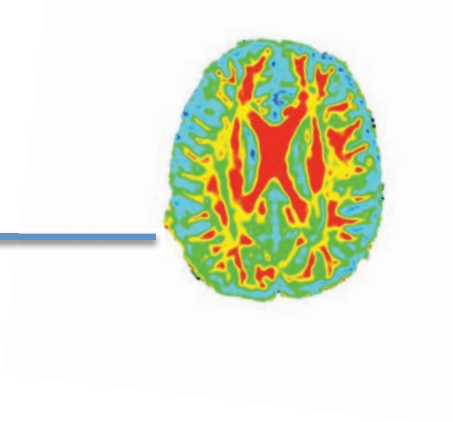
IRM multimodale & anoxie



L'IRM fonctionnelle à la Pitié

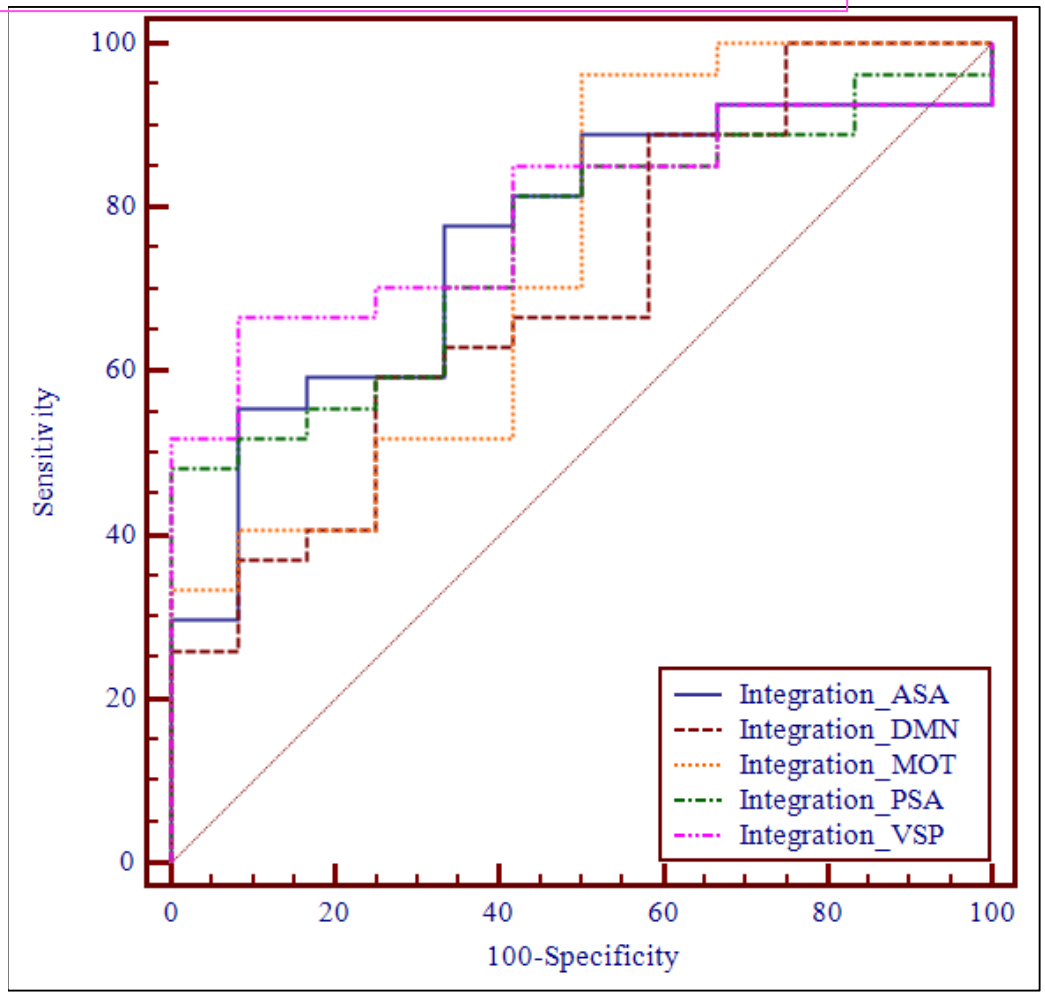


IRM multimodale & anoxie



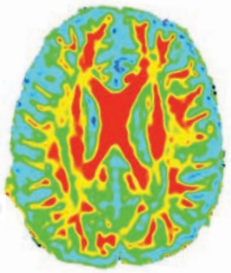
L'IRM fonctionnelle à la Pitié

intégration dans le VSP : AUC 0,79 (IC 95%: 0,63 – 0,91)



IRM multimodale & anoxie

IRM multimodale & anoxie

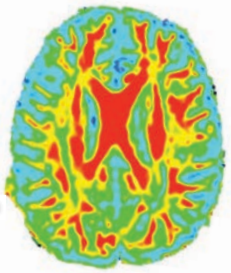


Willful Modulation of Brain Activity in Disorders of Consciousness

The NEW ENGLAND JOURNAL of MEDICINE

Laureys S, et al, NEJM, 2010

IRM multimodale & anoxie



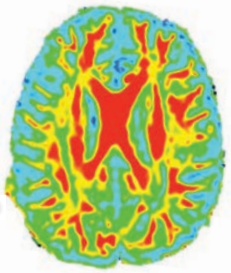
Willful Modulation of Brain Activity in Disorders of Consciousness

The NEW ENGLAND JOURNAL of MEDICINE

Patient No.	Location	Age	Sex	Diagnosis on Admission	Cause of Disorder
23	Liege	22	Male	VS	TBI

Laureys S, et al, NEJM, 2010

IRM multimodale & anoxie



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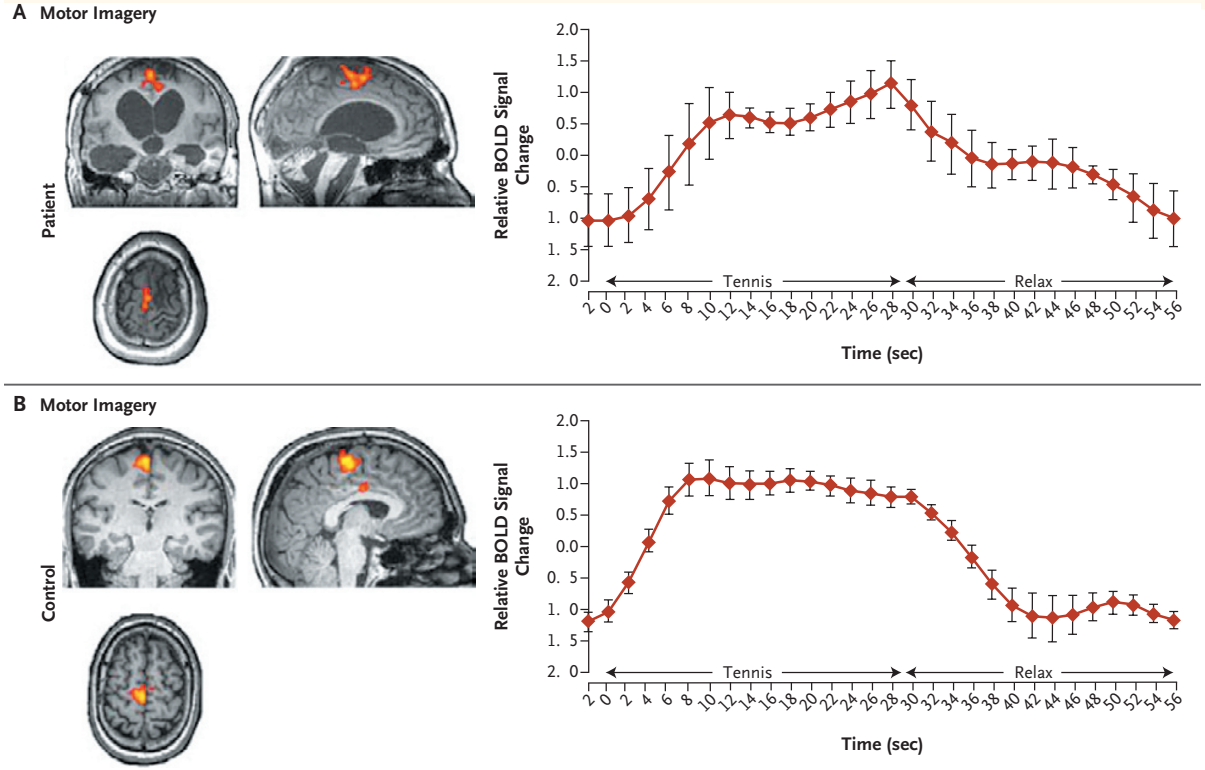
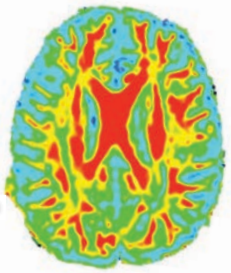


Laureys S, et al, NEJM, 2010

IRM multimodale & anoxie



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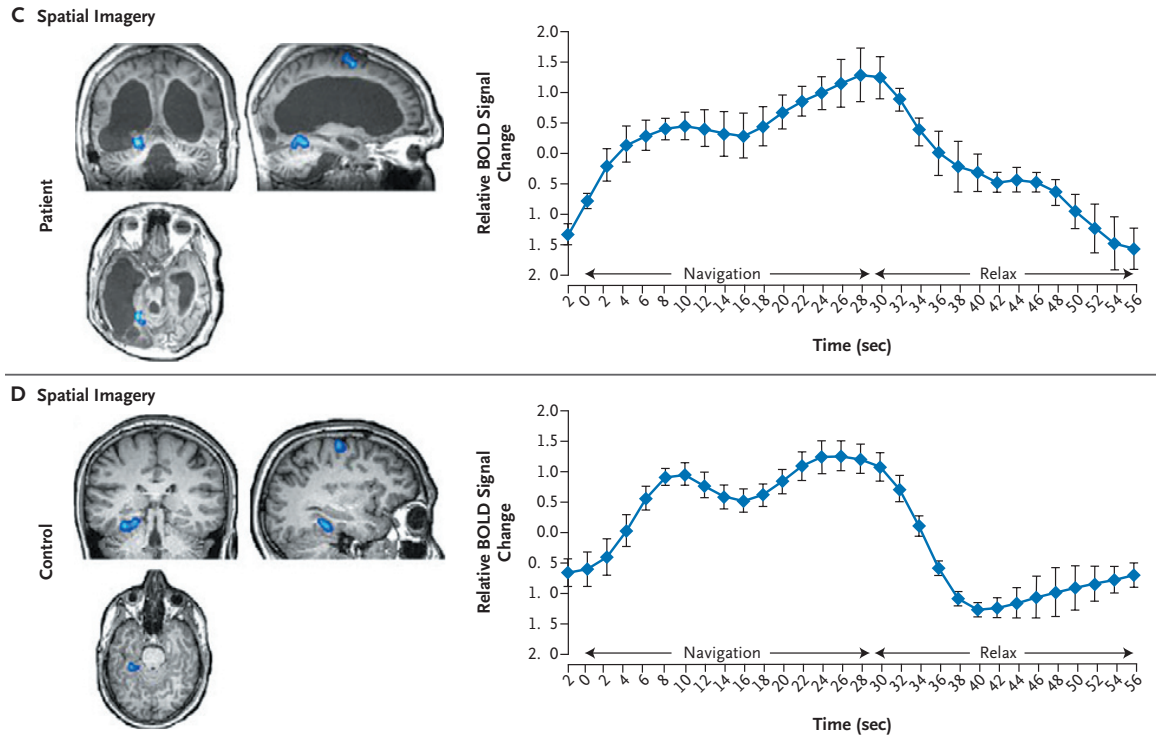
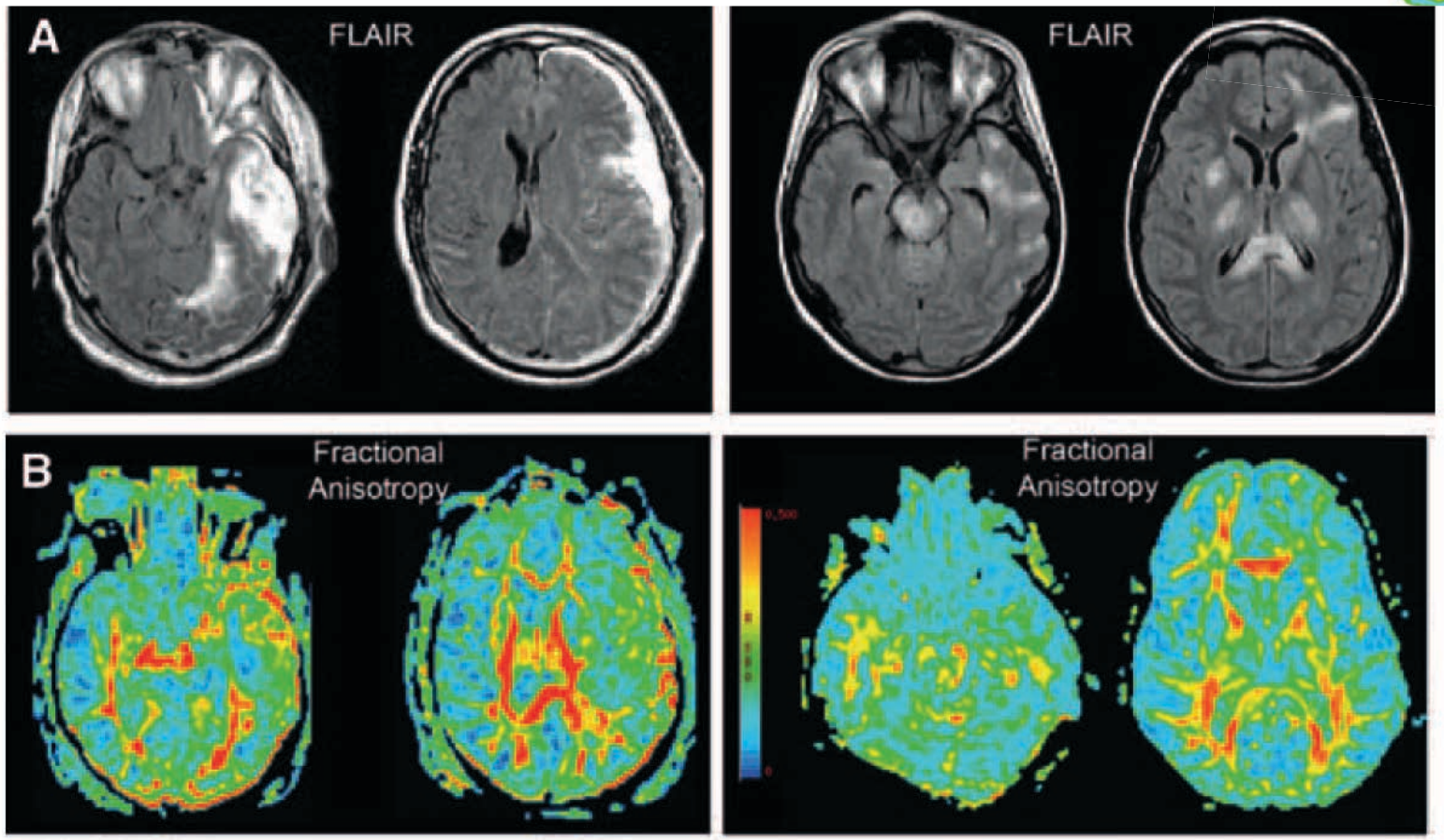


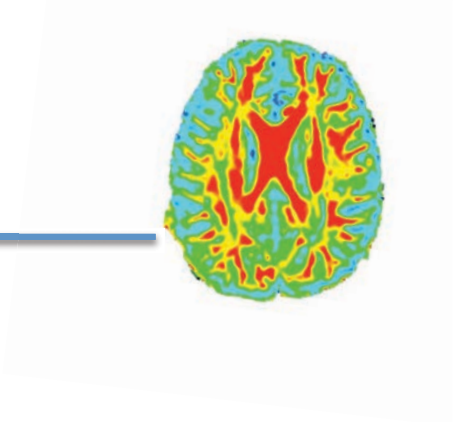
Laureys S, et al, NEJM, 2010

IRM multimodale & TBI



TBI=Distribution hétérogène des lésions

IRM multimodale & TBI



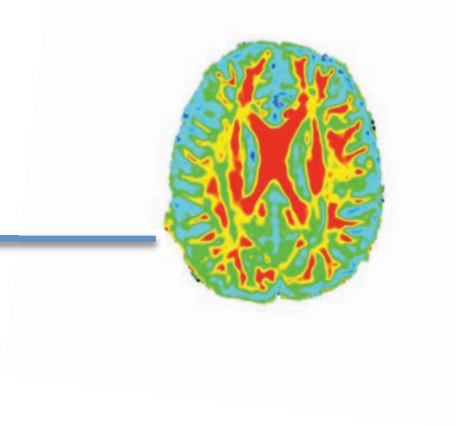
ComaSoft REPORT - 13/01/15

DISCLAIMER
The conclusions obtained with the COMASOFT software is an help to the diagnosis and to the prognosis. They do not substitute themselves for the clinical decisions of the clinicians which remain responsible for their diagnosis, for their prognosis, for their prescriptions and for their clinical care in any circumstances. The conclusions supplied by the tool through the COMASOFT report are it as a rough guide. They would not know how to exempt the user of combining all the arguments necessary for his decision. They can be used on no account in a isolated way.
As a consequence, AP-HP, UPMC and Inserm can have on no account responsible for any direct or indirect damage resulting from the use of the data, the information or the results stemming from this COMASOFT software. The user recognizes to use this information under his only exclusive responsibility.

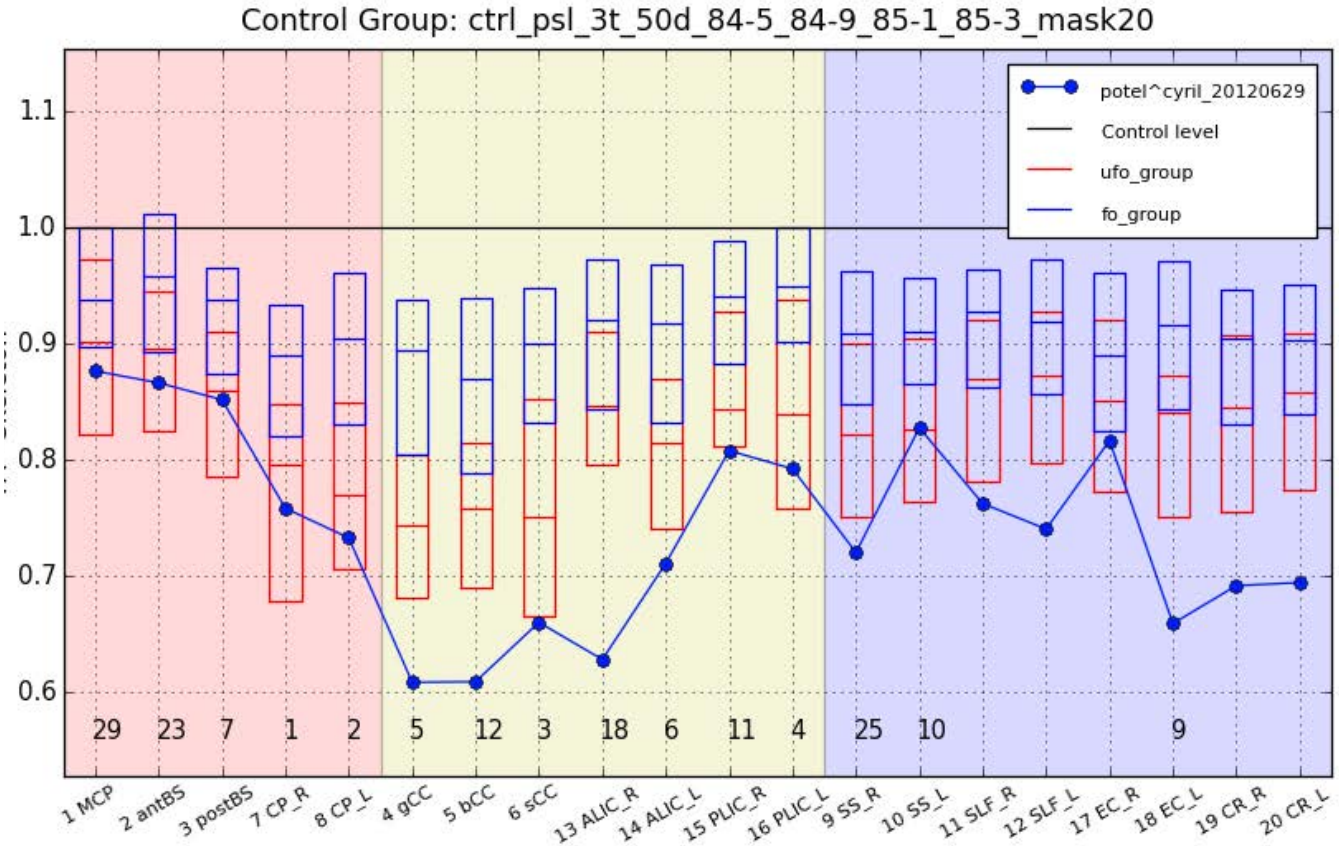
DECHARGE DE RESPONSABILITE
Les conclusions obtenues grace au systeme logiciel COMASOFT constituent une aide au diagnostic et au pronostic. Elles ne se substituent pas aux decisions cliniques des praticiens qui demeurent responsables de leur diagnostic, de leur pronostic, de leurs prescriptions et de leur prise en charge en toutes circonstances. Les conclusions fournies par l outil a travers le rapport COMASOFT le sont a titre indicatif. Elles ne sauraient dispenser l utilisateur de reunir tous les arguments necessaires a sa decision. Elles ne peuvent en aucun cas etre utilisees de maniere isolee.
En consequence, l AP-HP, l UPMC et l Inserm ne pourront en aucun cas etre tenus responsables de tout dommage direct ou indirect resultant de l utilisation des donnees, informations ou resultats issus de ce systeme logiciel COMASOFT. L utilisateur reconnait utiliser ces informations sous sa seule responsabilite exclusive..

PATIENT REFERENCE :	potel^cyril_20120629
DTI CONTROLS GROUP :	ctrl_psl_3t_50d_84-5_84-9_85-1_85-3_maskTracts
CLASSIFIER :	TBI_mask20_GOS[1,3-]_GOS[3+,5]
UFO SCORE :	**0.871**
CLASSIFIER :	TBI_mask20_WM_FA_GOS[1,3-]_GOS[3+,5]
UFO SCORE :	**0.389**
CLASSIFIER :	TBI_maskTracts_DRS<5_DRS>=5
UFO SCORE :	**0.905**

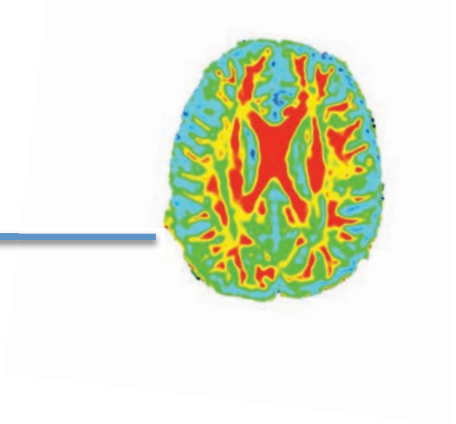
IRM multimodale & TBI



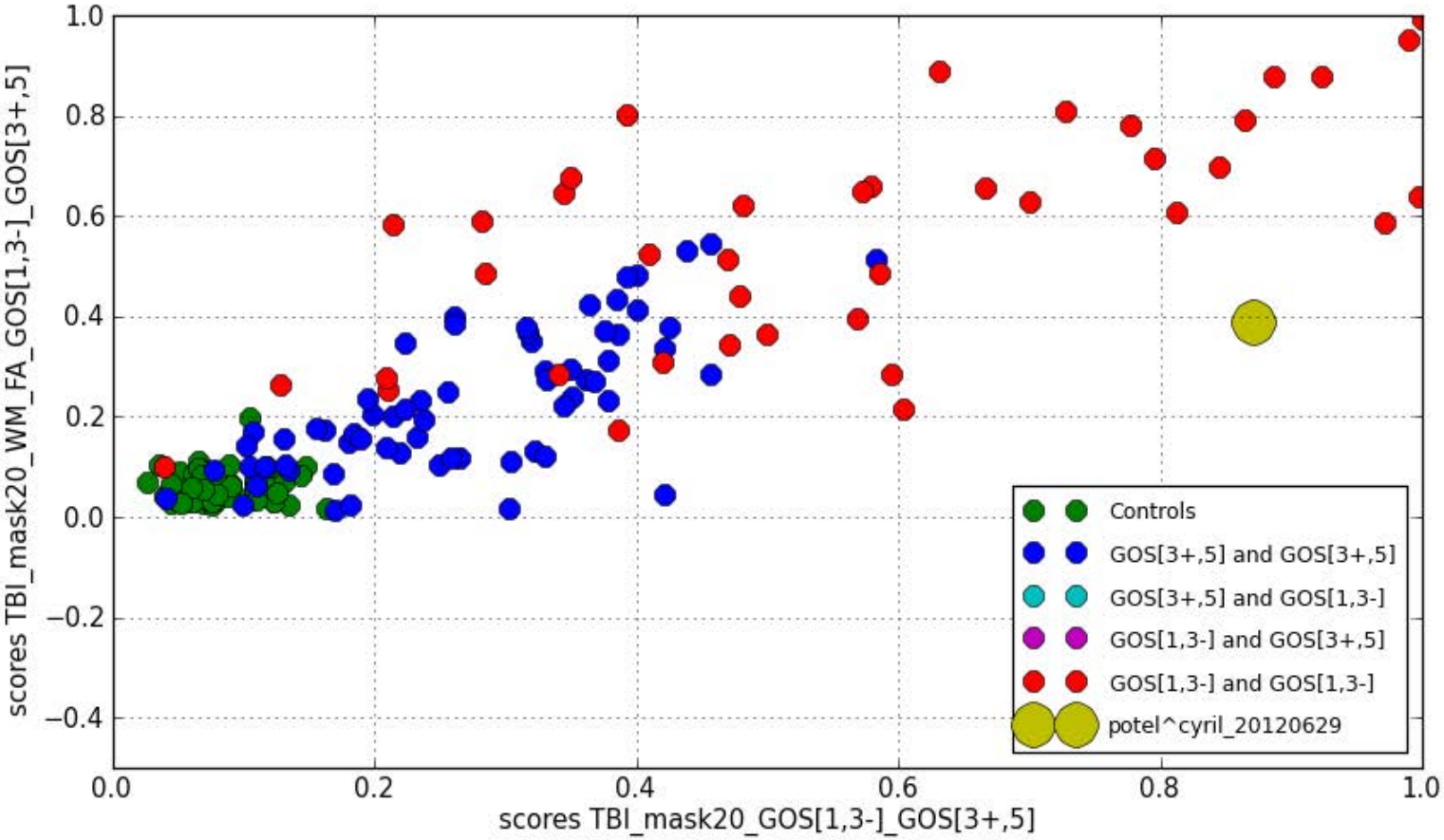
Fractional Anisotropy



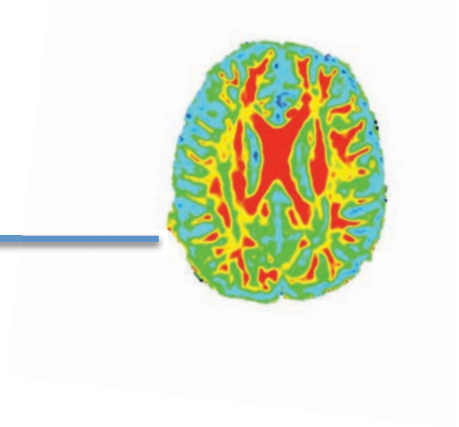
IRM multimodale & TBI



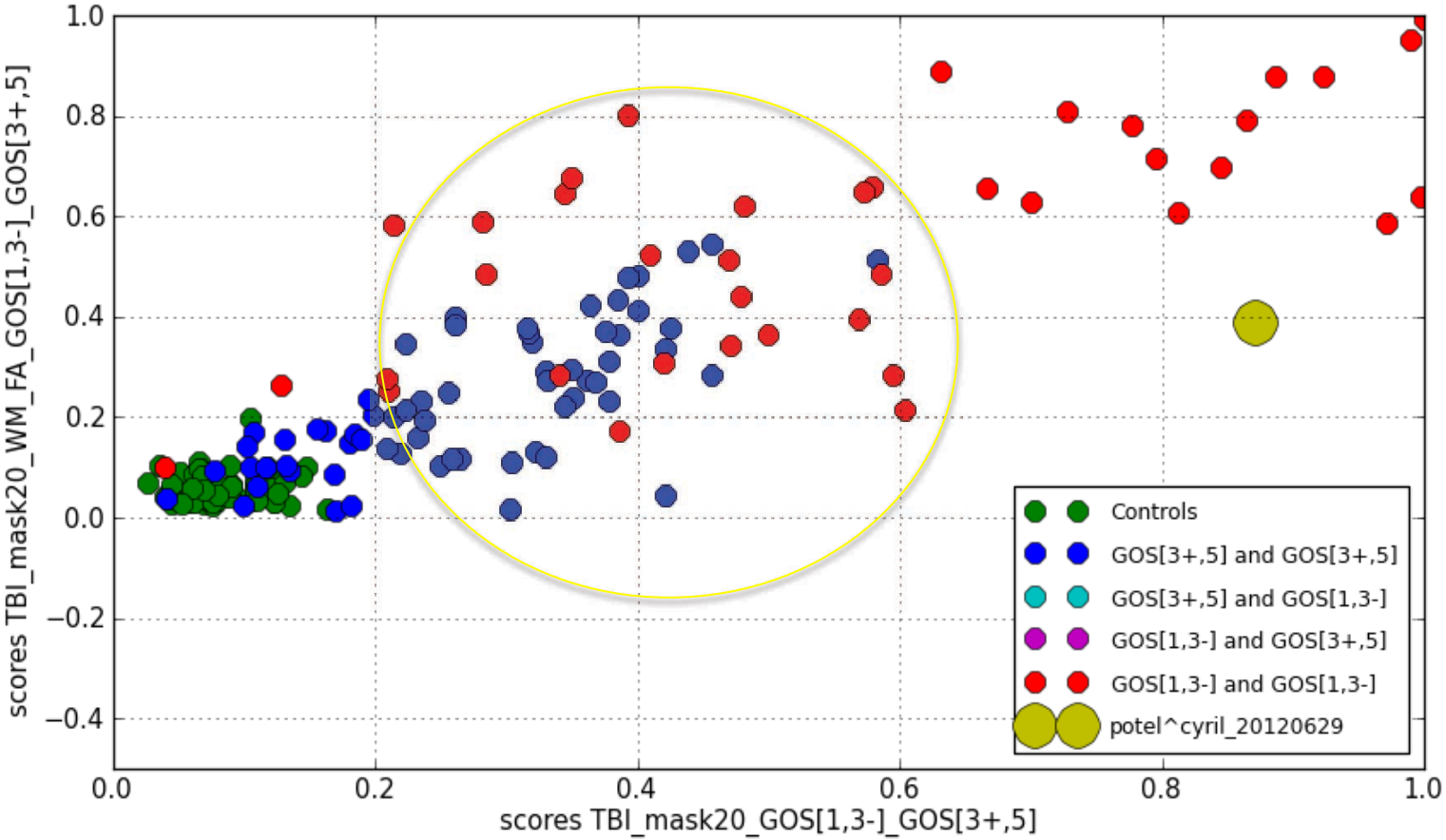
Outcome Prediction : Scatter Plot



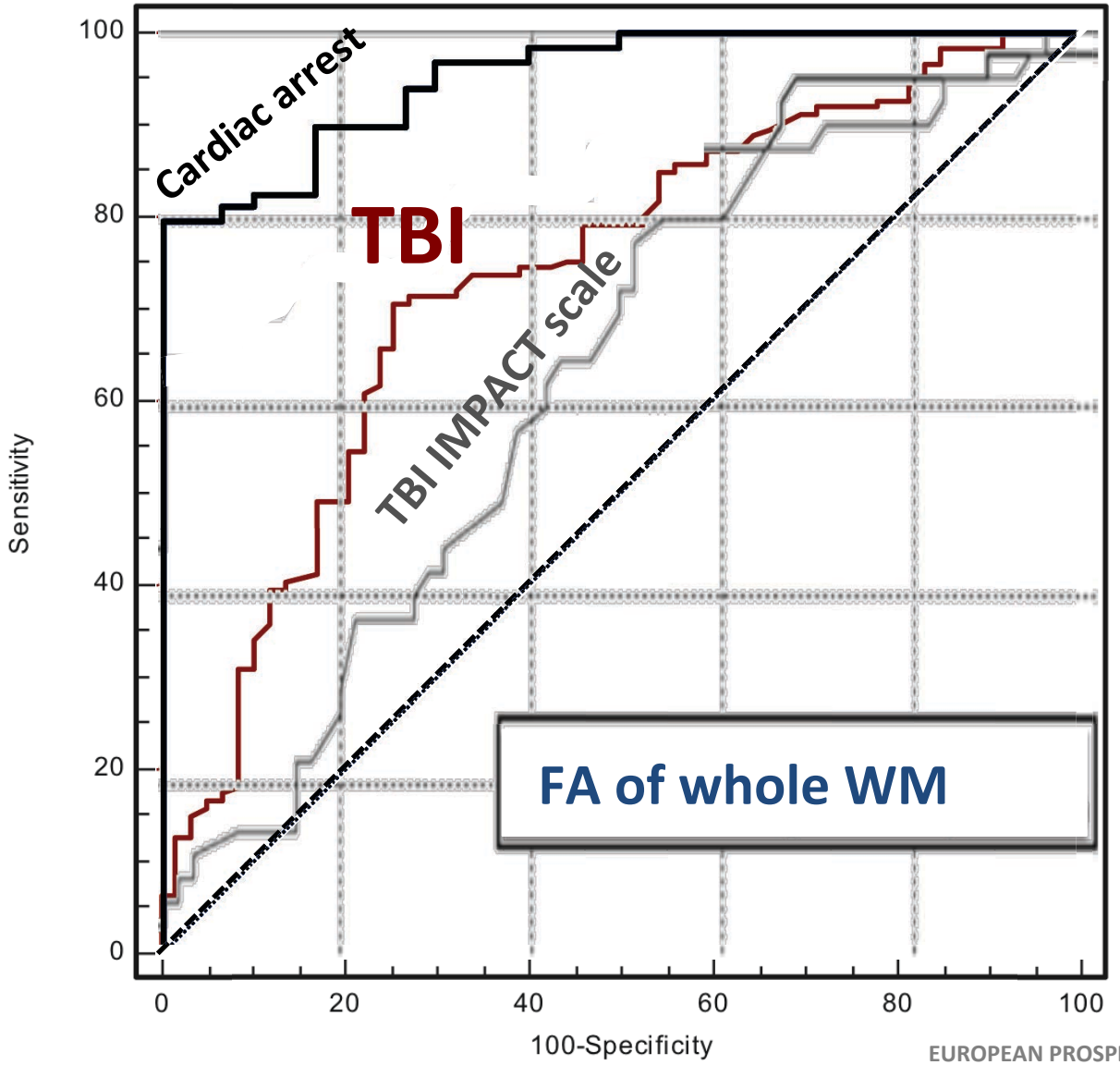
IRM multimodale & TBI



Outcome Prediction : Scatter Plot



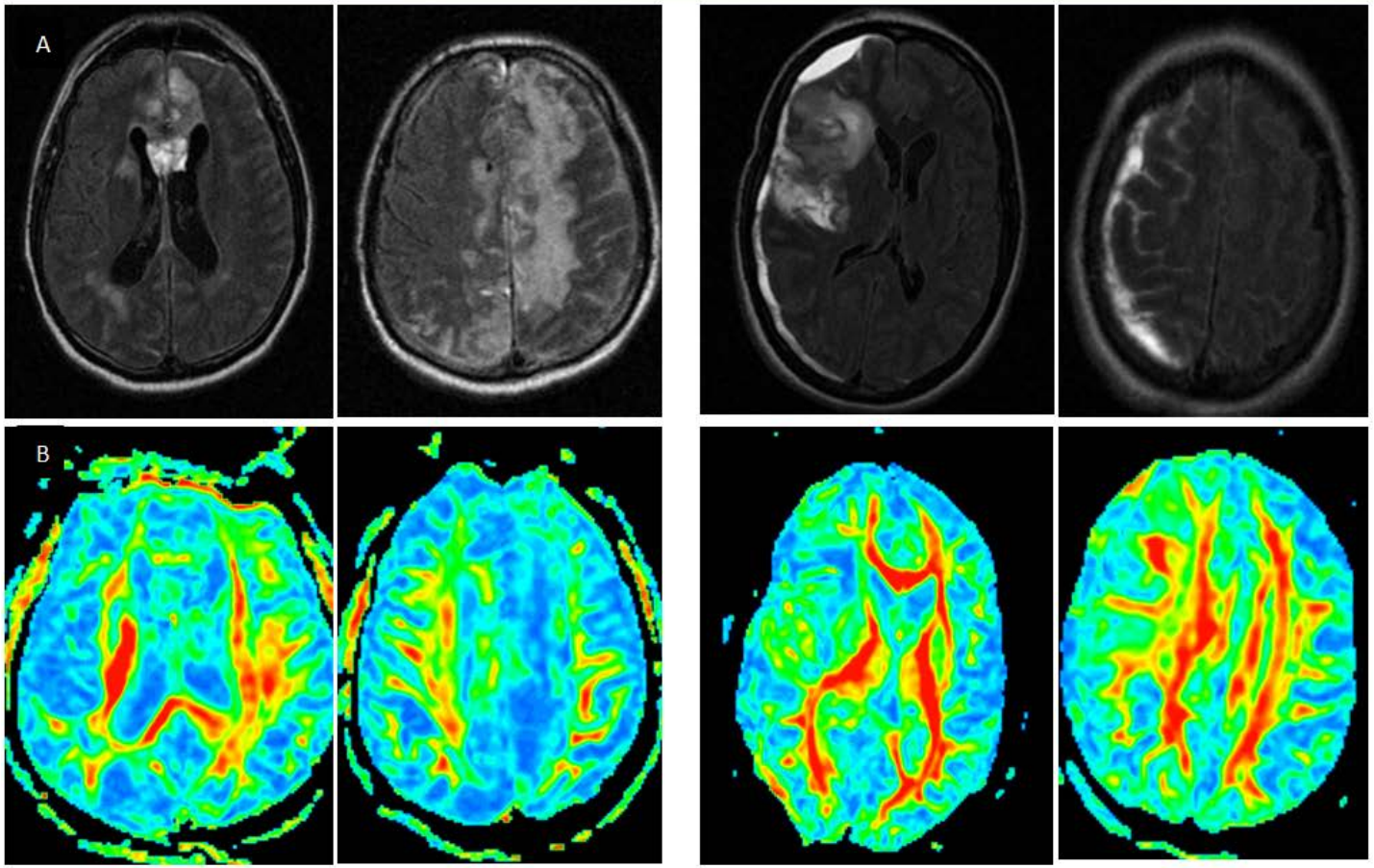
IRM multimodale & TBI



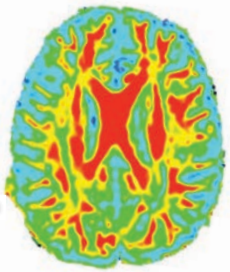
240 TBI in16 ICU

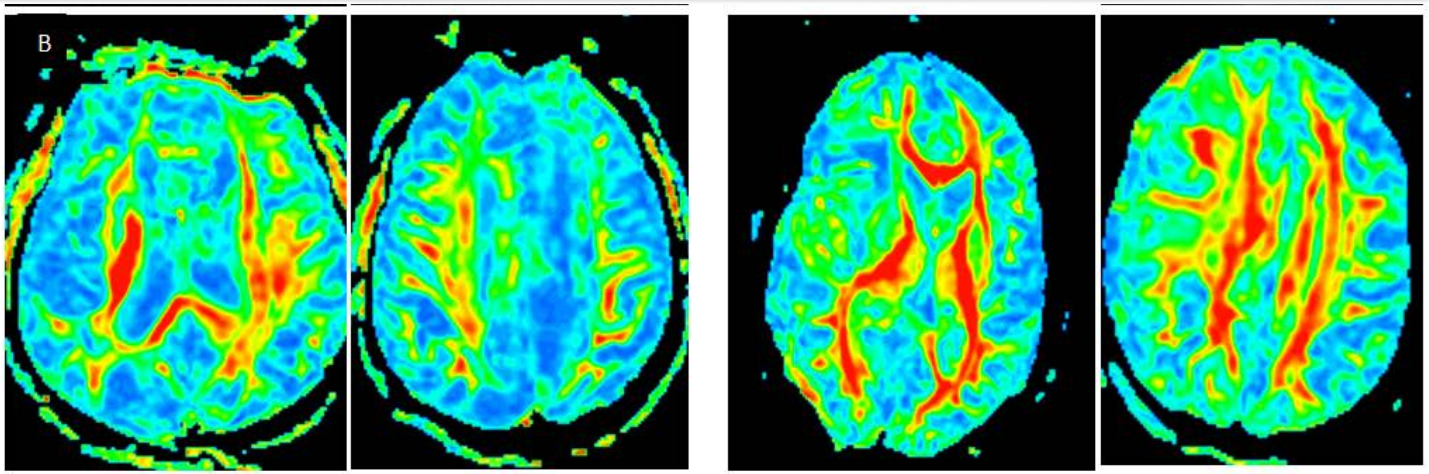
EUROPEAN PROSPECTIVE MULTICENTER STUDY

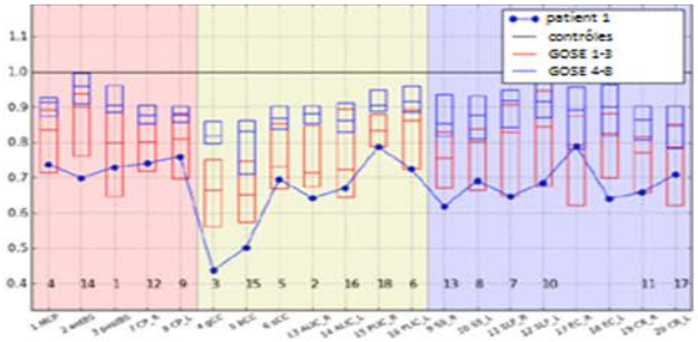
IRM multimodale & HSA

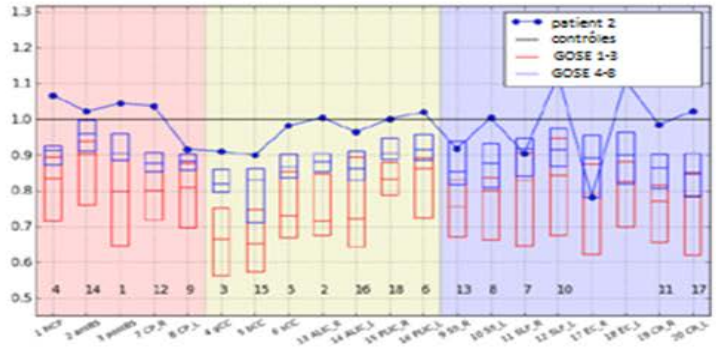


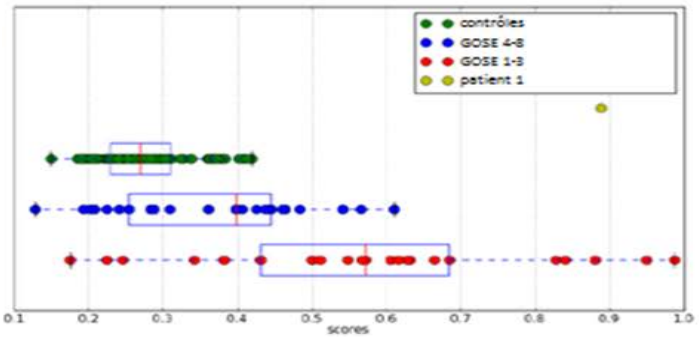
IRM multimodale & HSA

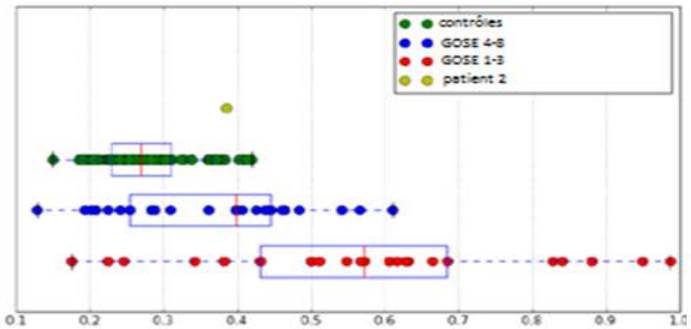




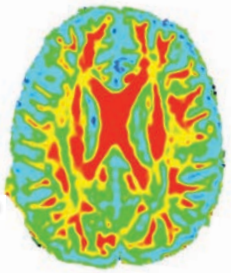


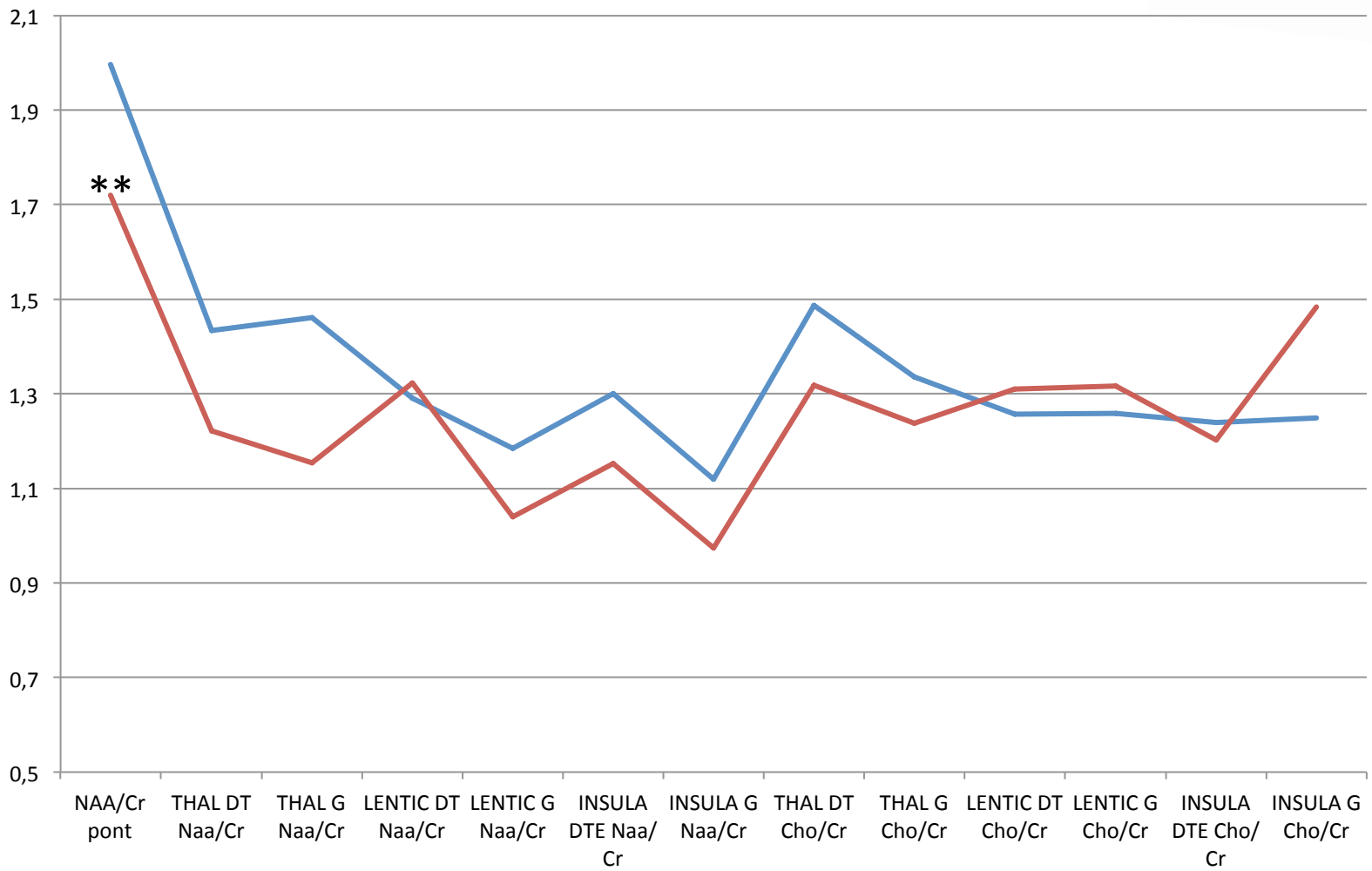




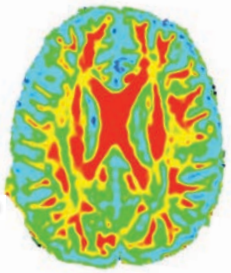


IRM multimodale & HSA



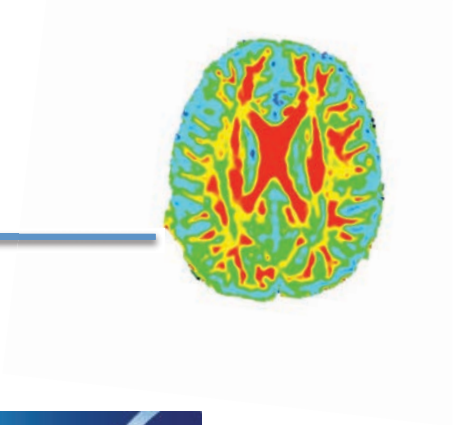


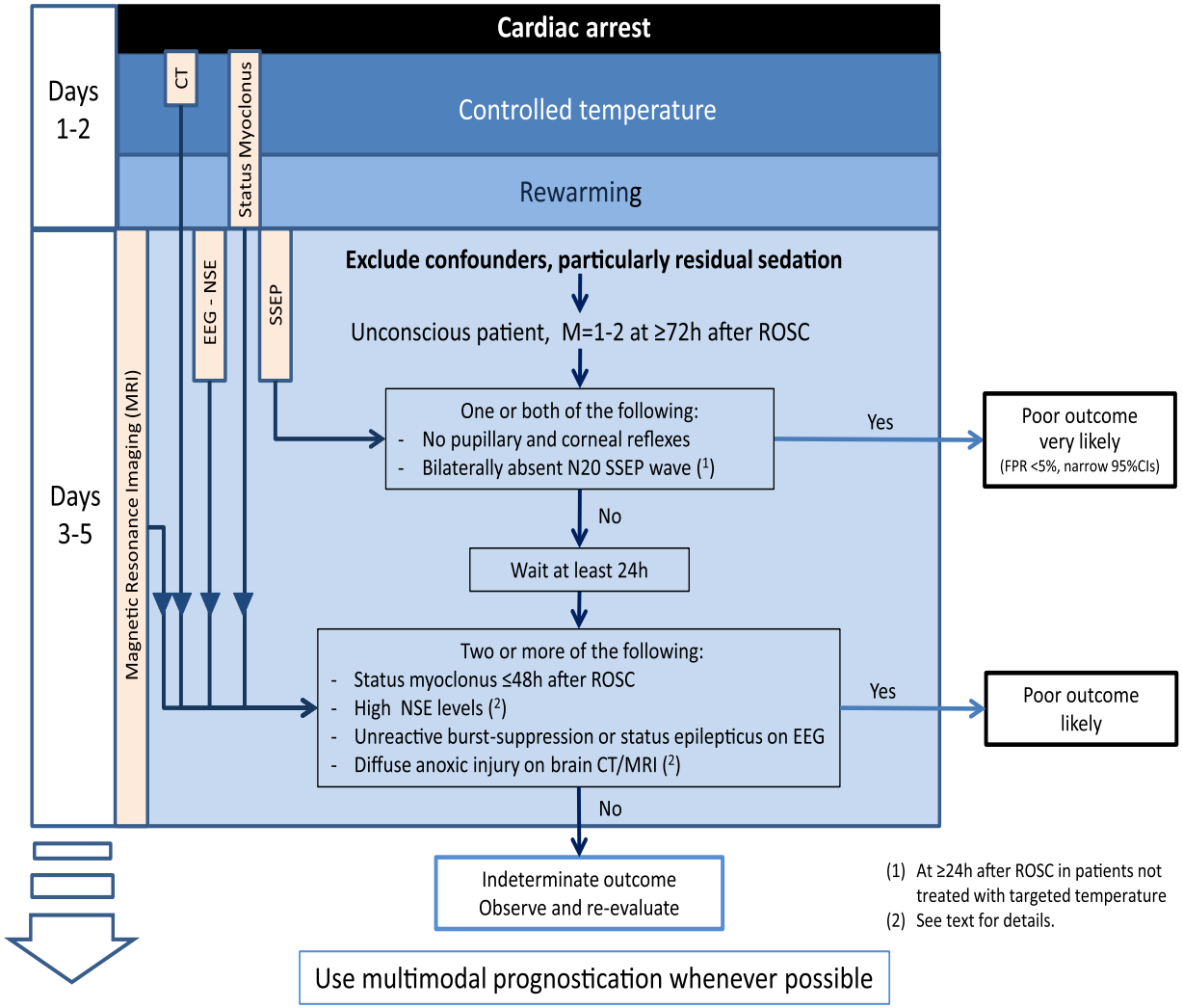
Conclusion



- Après anoxie cérébrale, en cas d'absence de réveil après 7 jours, l'IRM multimodale (DTI +SRM) permet de répondre dans quasi 100% des cas
- En cas de coma après TC grave, large zone grise du DTI
- Résultats plus prometteurs dans l'HSA

Conclusion





Recommandations European society of ICM, 2014