

Les néo neuro spins s'écoulent aussi ... plus ou moins bien !

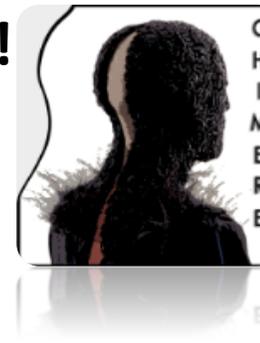
Olivier Balédent, B De Waele, M Aye, C Gondry jouet, C Capel.

Chimère UR 7516, University of Picardie Jules Verne, Amiens, France.

Radiology department, University hospital, Amiens, France.

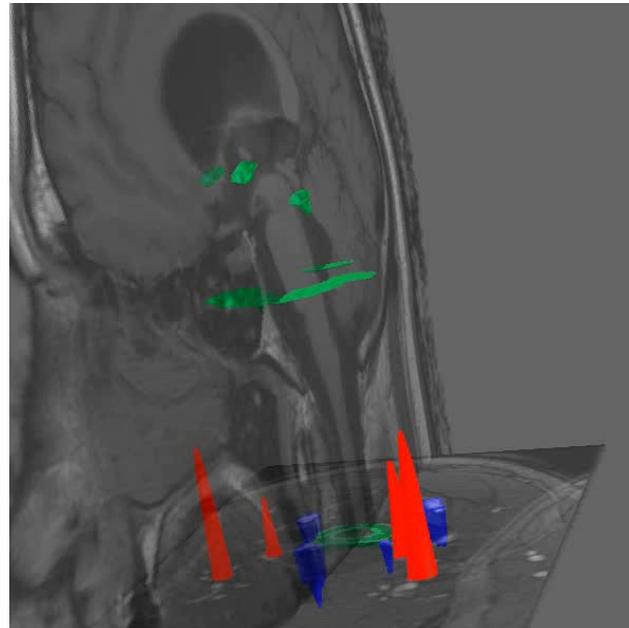
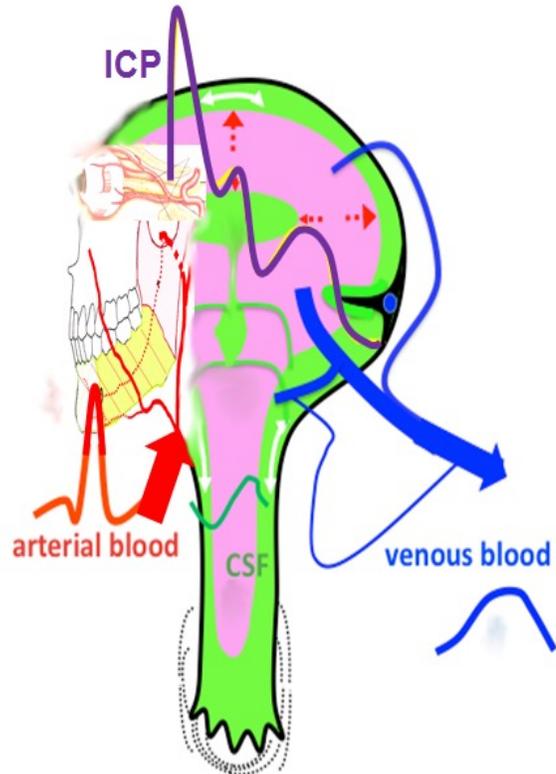
Neurosurgery department, University hospital, Amiens, France.

Image processing department, University hospital, Amiens, France.



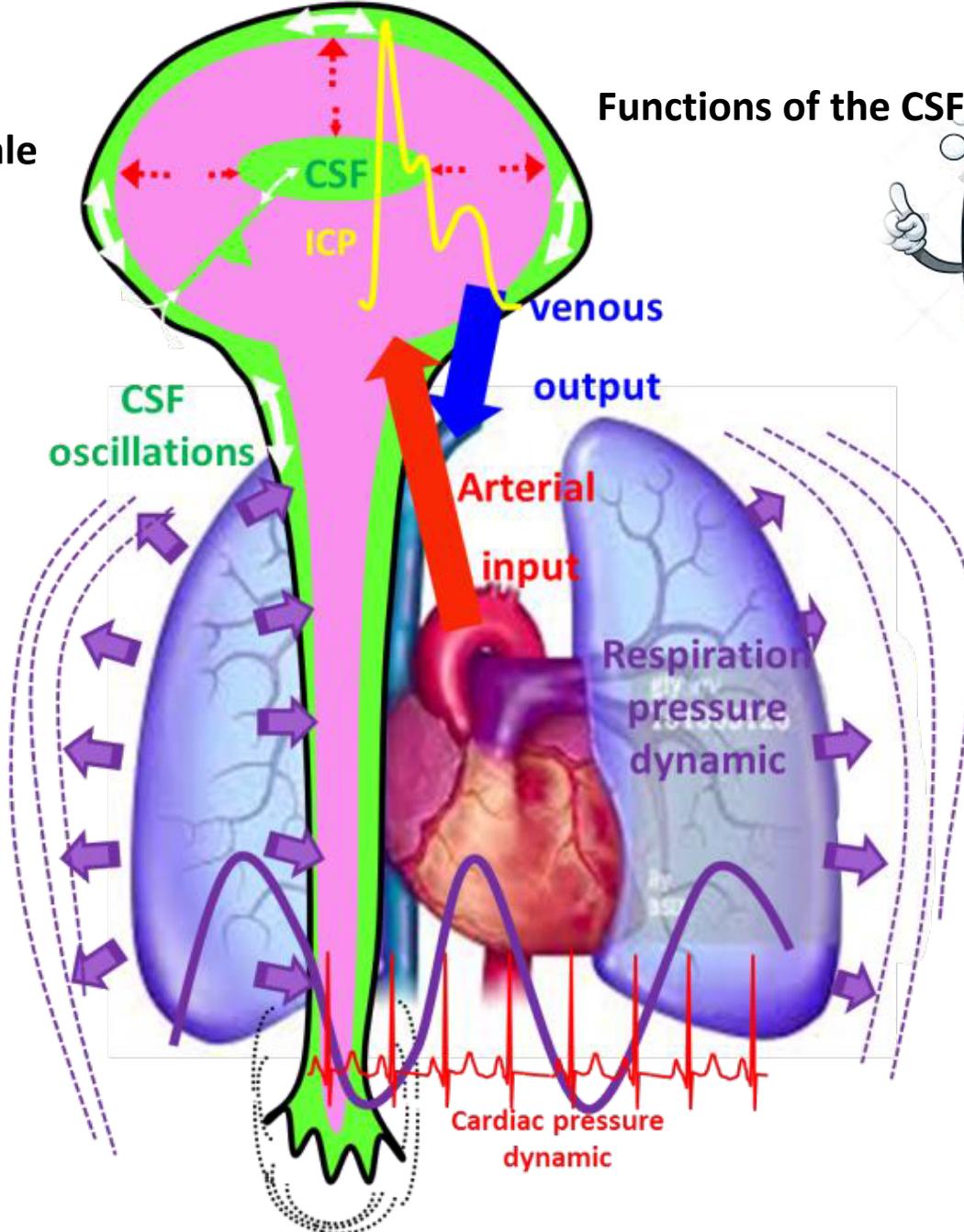
Université de Picardie Jules Verne, UR 7516 Chimère, Groupe de recherche Tête et Cou

Unité de traitement de l'image médicale du CHU Amiens.

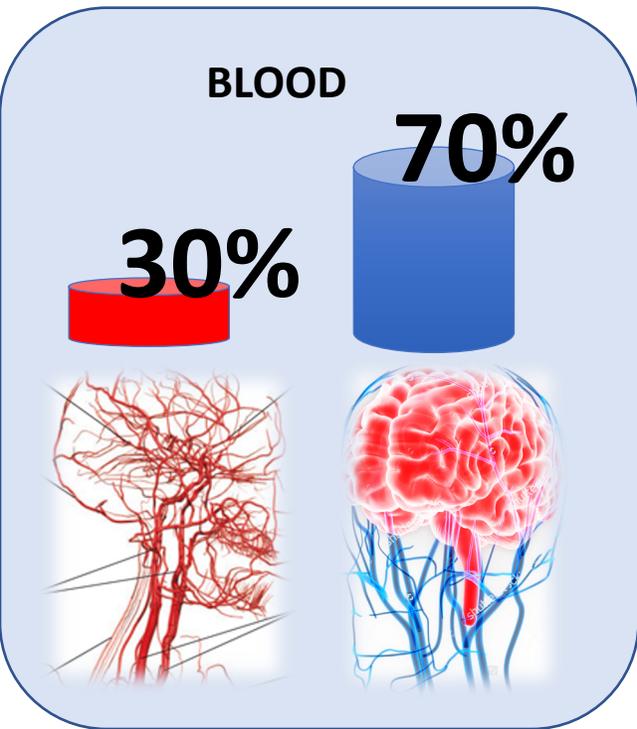


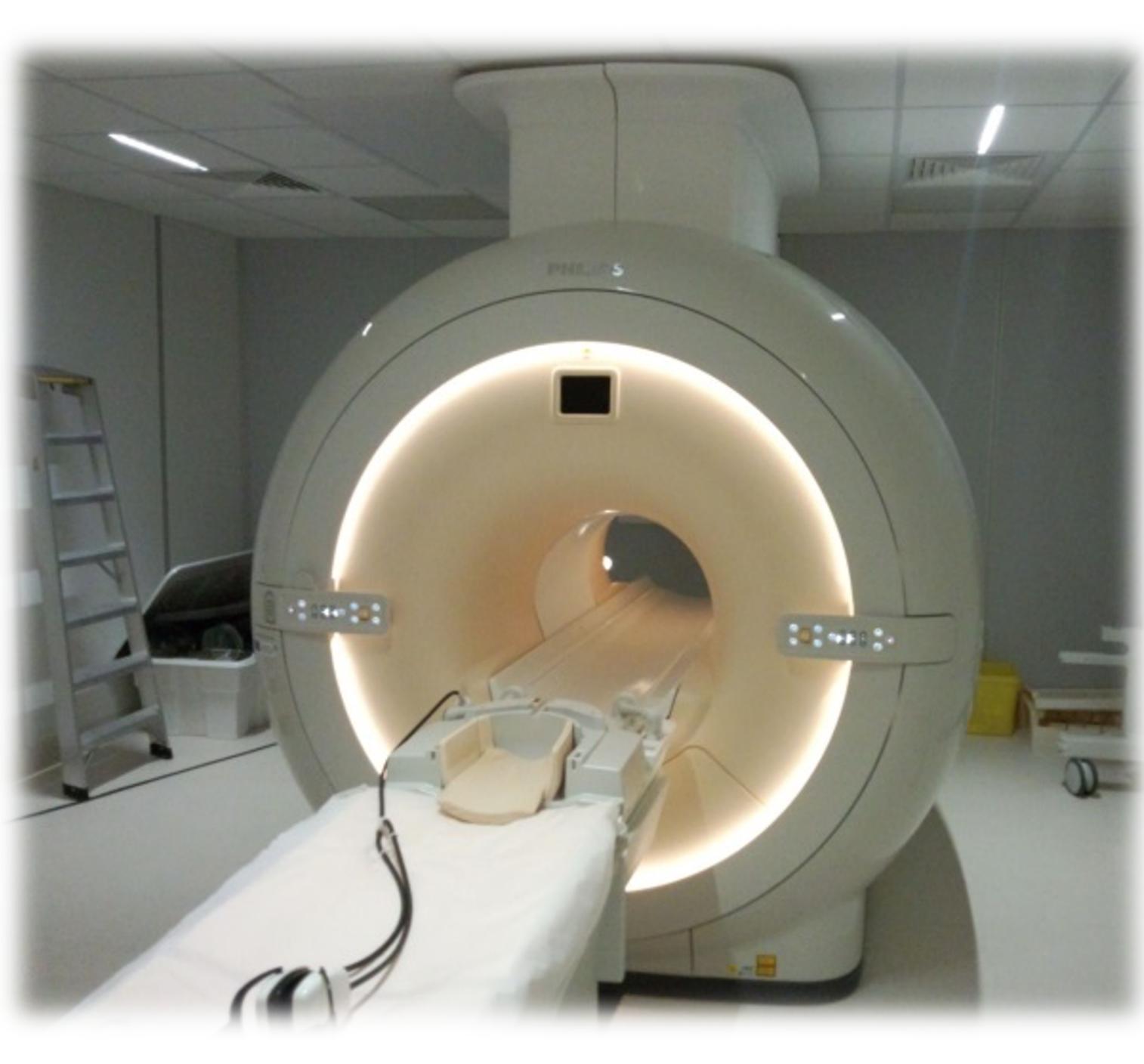
L'hydro hémodynamique cérébrale

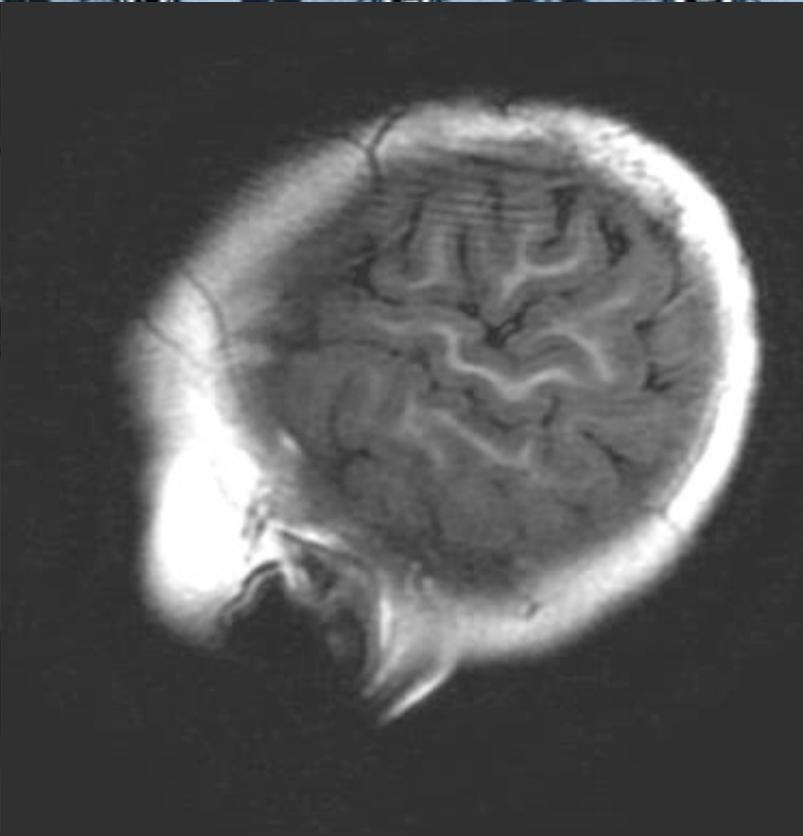
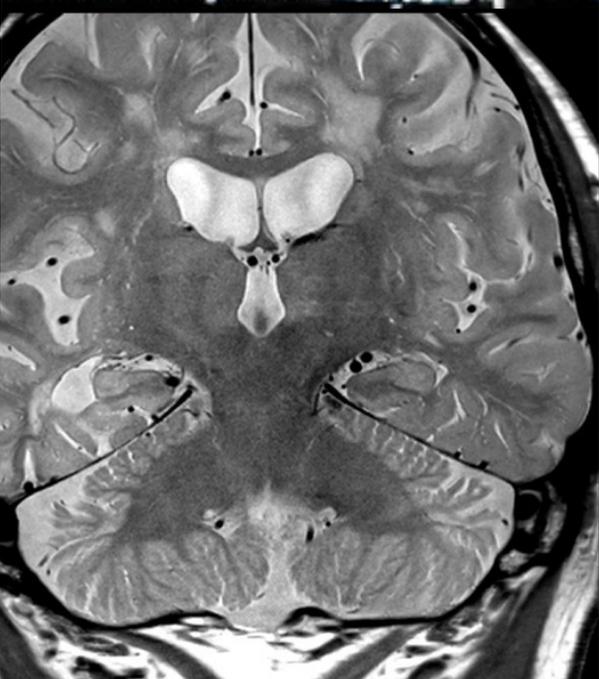
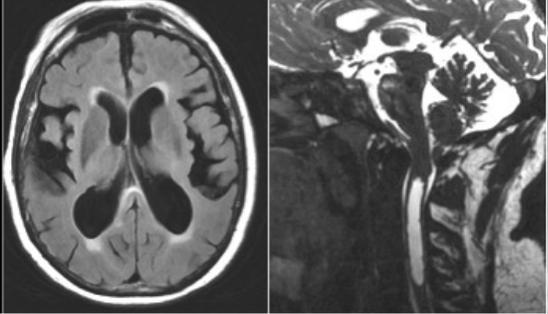
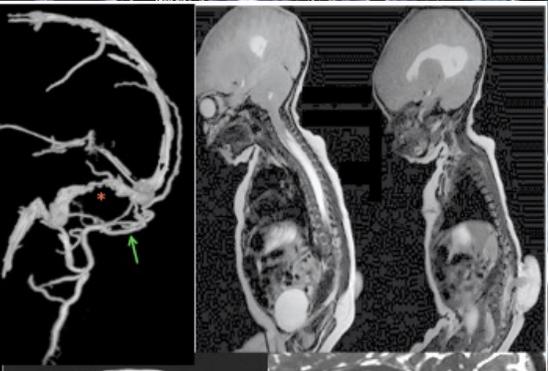
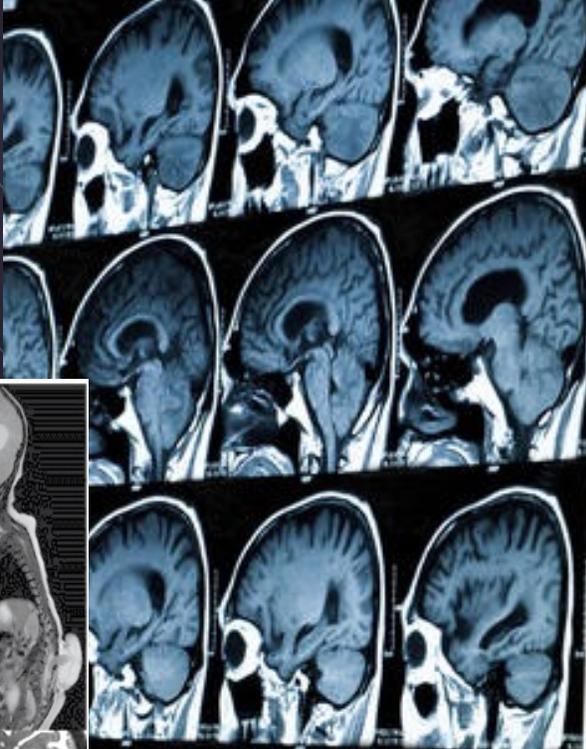
Functions of the CSF

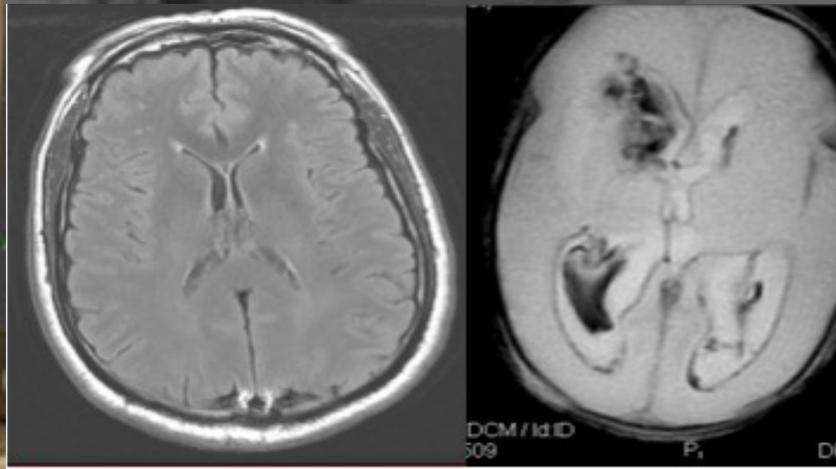
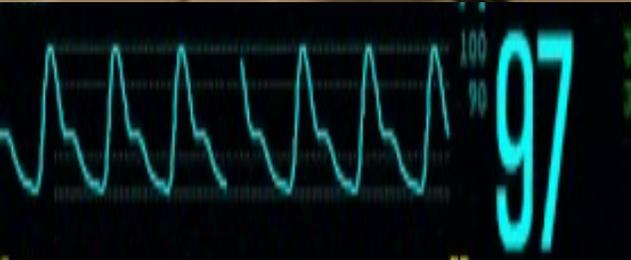
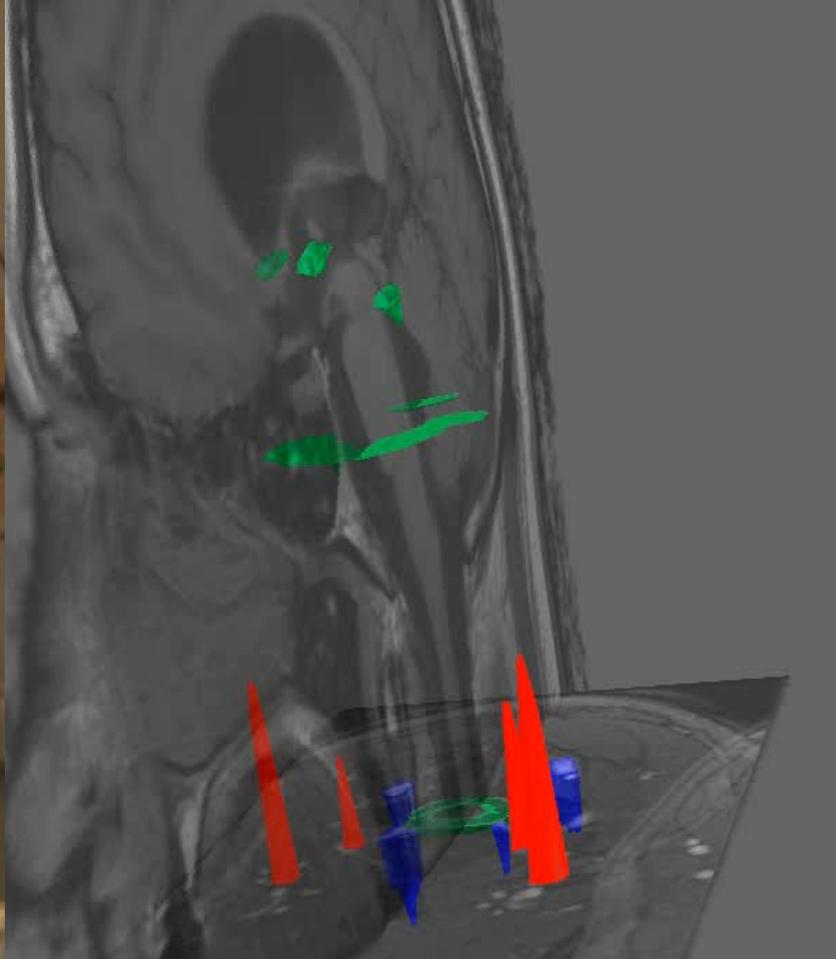


Gérer la pression









Objectives

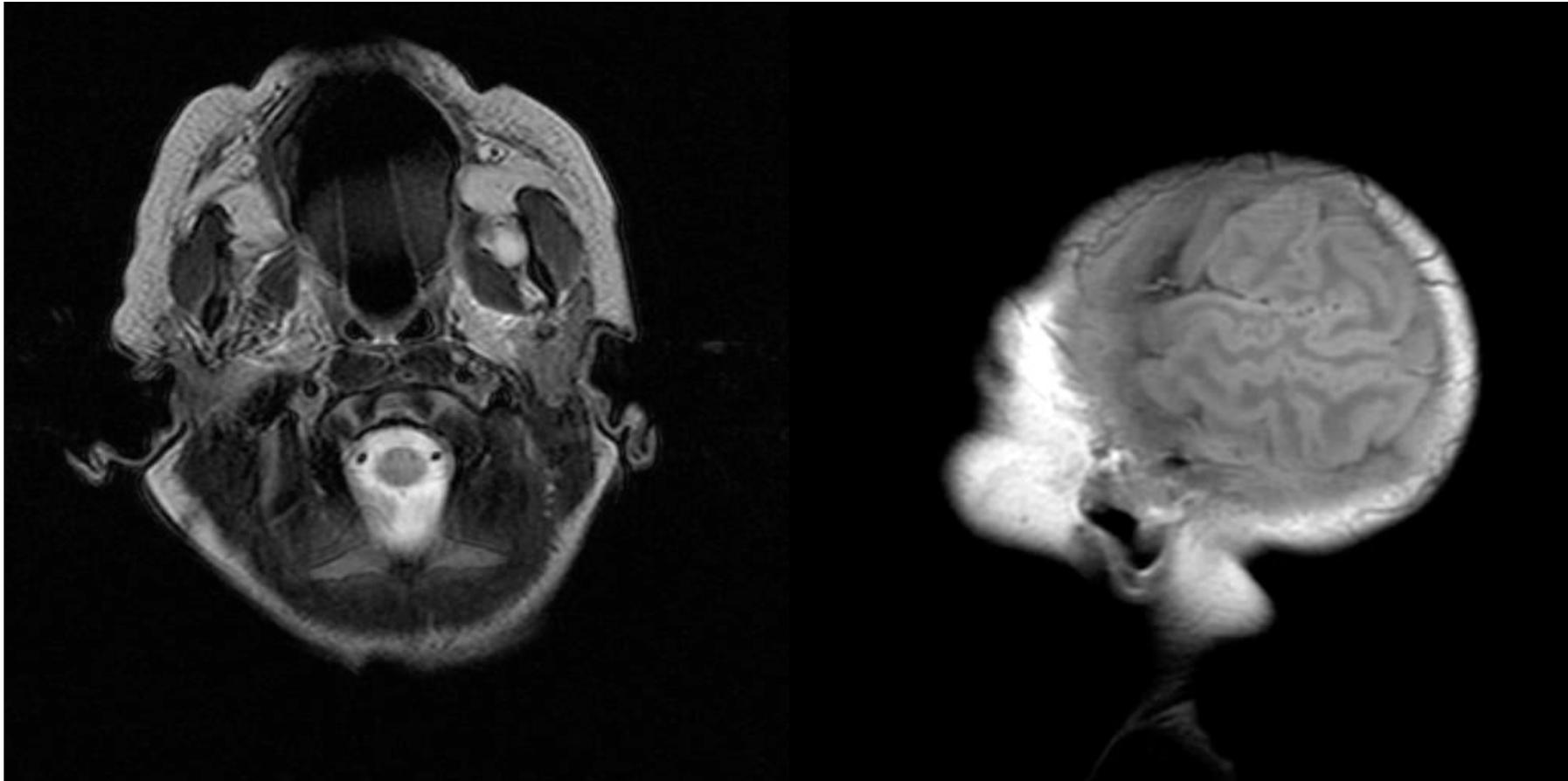
Evaluate PCMRI in clinical practice for pediatric population

Quantify CSF and cerebral blood flows changes with age in the first life periods

Evaluate impact of haemorrhage (IVH) newborn populations in cerebral hydrodynamic

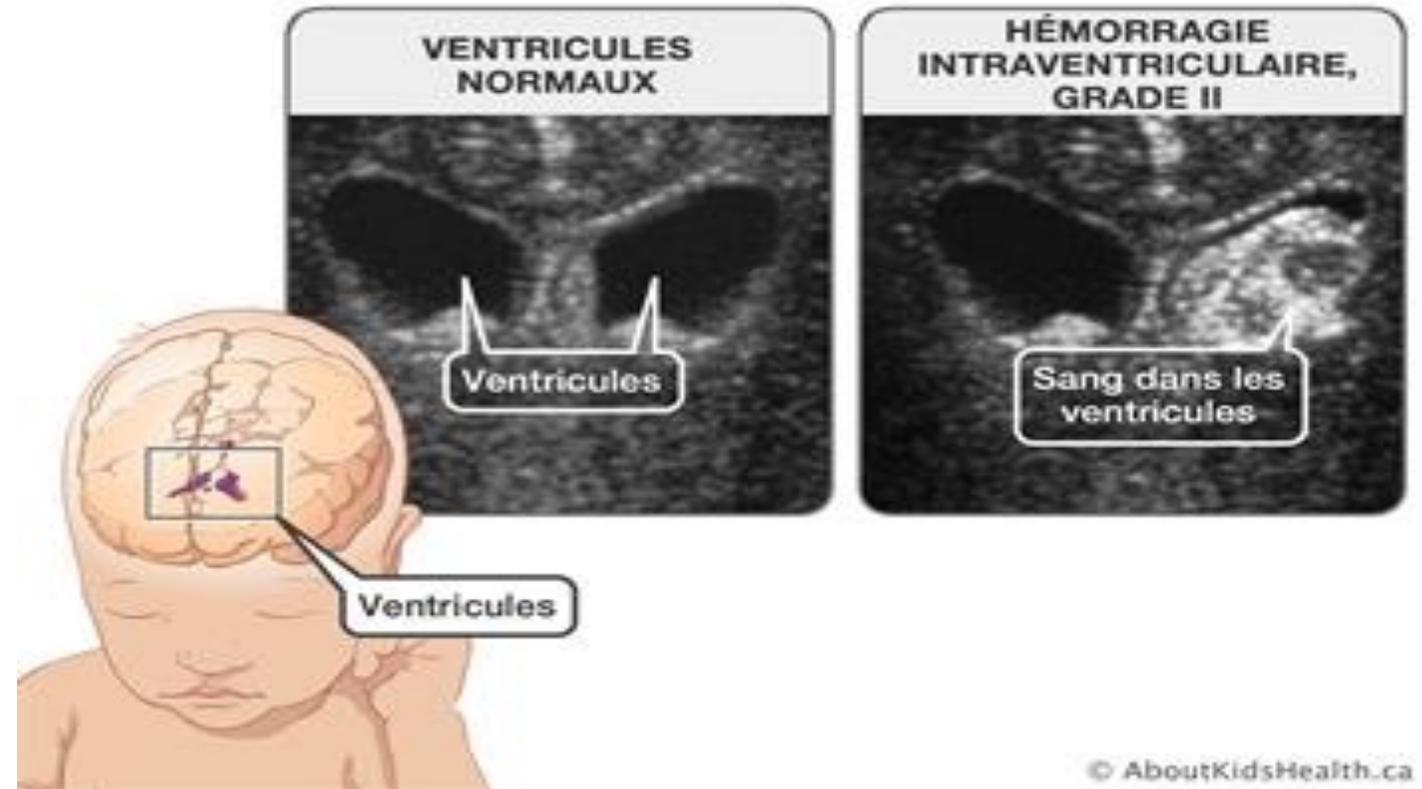
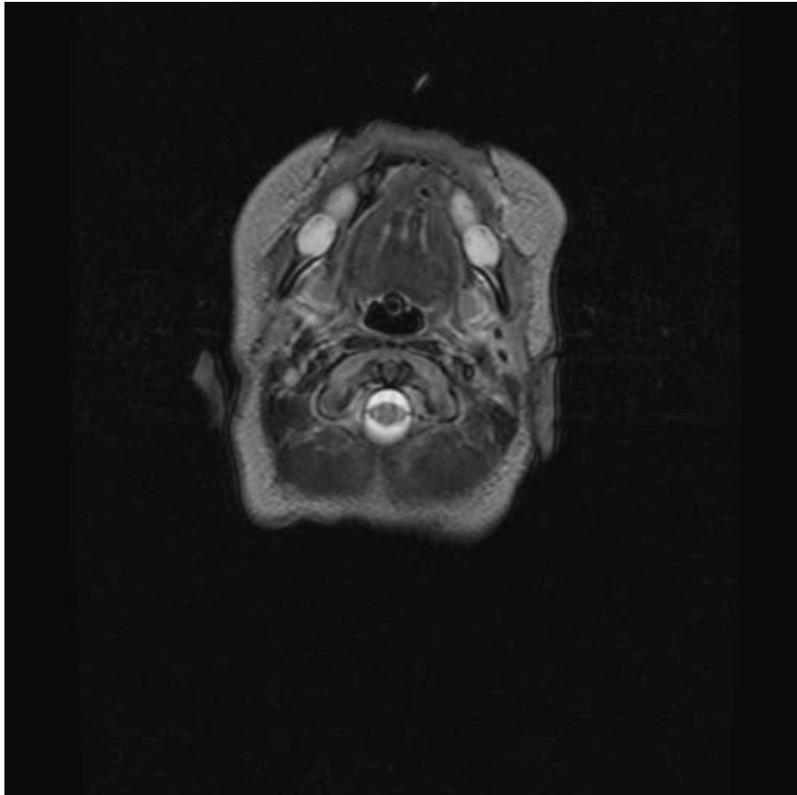
Population explored

36 newborns and children (5 days-8 years) who underwent cerebral MRI, for neurological dysfunctions without radiological evidence of brain injury, were defined as a control group.



Population explored

12 premature newborn between 22 and 39 weeks whom presented ventricular dilation associated with intra-ventricular haemorrhage (IVH) were included.



Hémorragies de la matrice germinale périventriculaire pouvant rompre la barrière ependymaire pour se propager dans les ventricules .
Lésion cérébrale typique de la prématurité : fragilité vasculaire + variations du débit sanguin

Materials & Methods

Signa HDx 3T GE Medical Healthcare

Morphological Imaging + Séquence fast cine phase contrast

Coils : depends of the newborn age (SAR !!!)

Slice thickness : 5 mm

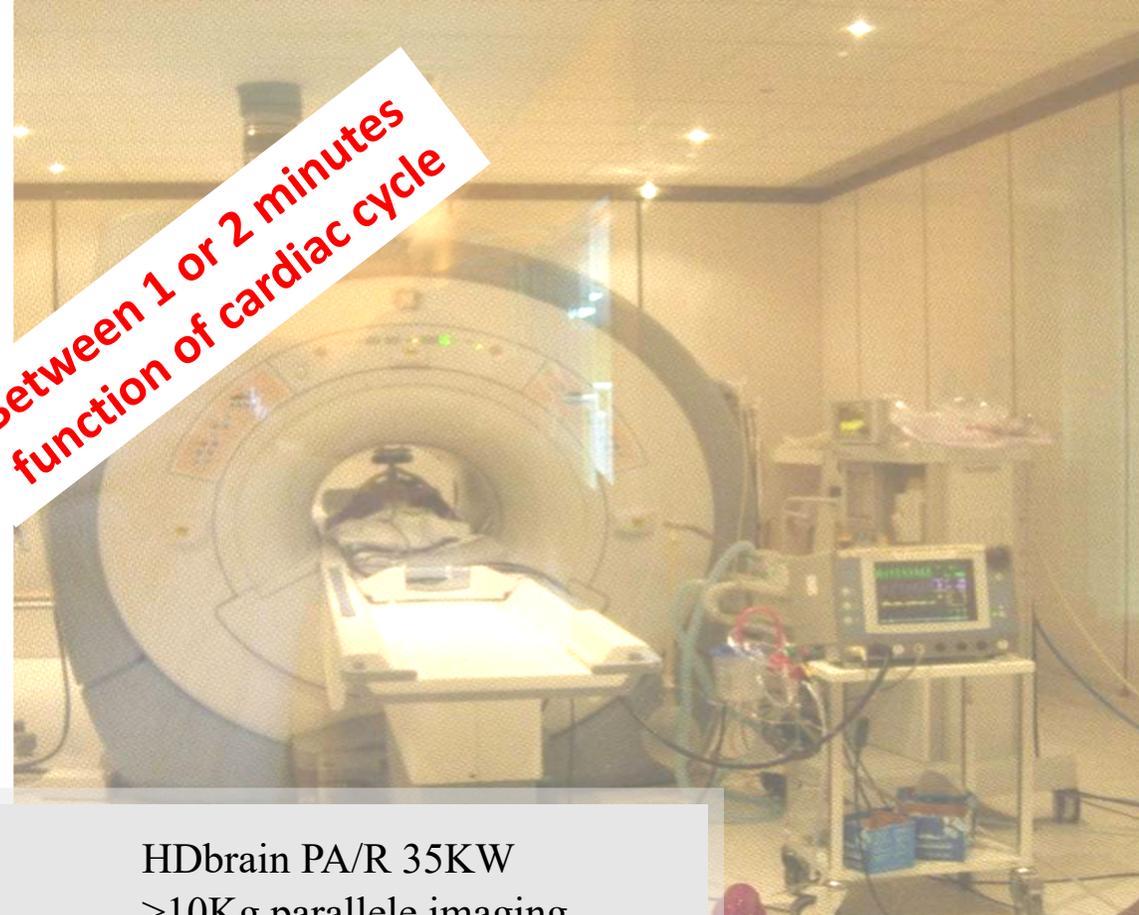
Matrix (mm²): 384 * 256 (aqueduct) and 256 * 256 (other levels)

FOV x : 140mm y : 98mm

Nex : 2 View per Segment : 2

Cardiac phases : 32 (Peripheral gating)

*Between 1 or 2 minutes
function of cardiac cycle*



Knee coil (E/R) 6KW
<1 month



Head coil (E/R) 6KW
<10Kg



HDbrain PA/R 35KW
>10Kg parallele imaging



Acquisition des images : le LCS

Positionnement de la coupe dans l'aqueduc de Sylvius chez un nourrisson âgé d'une semaine.

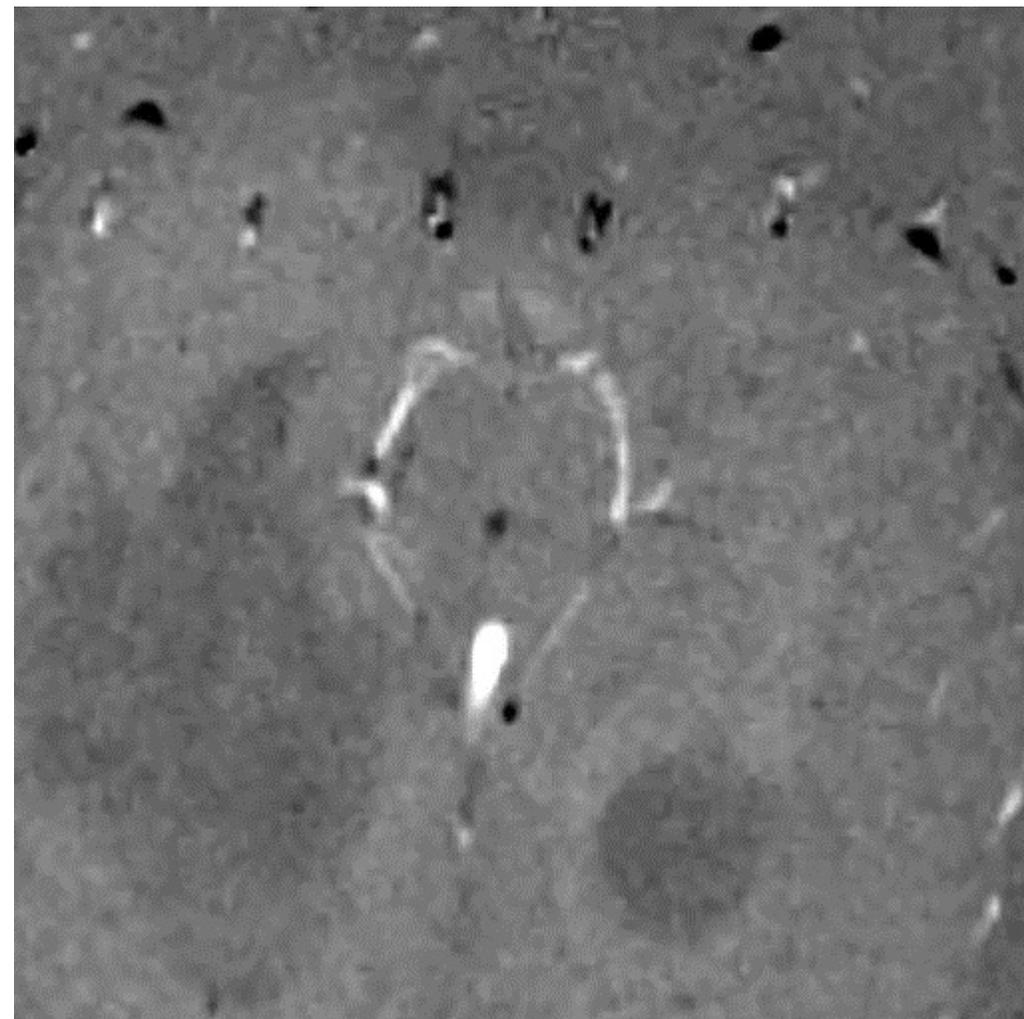
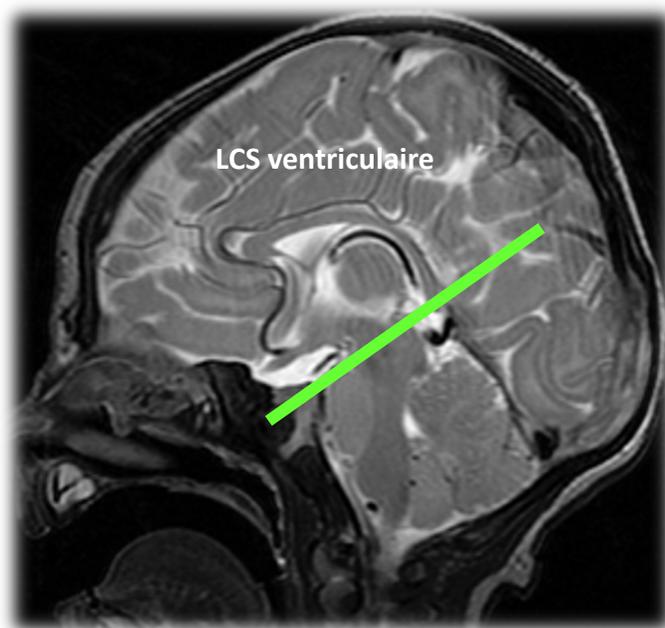
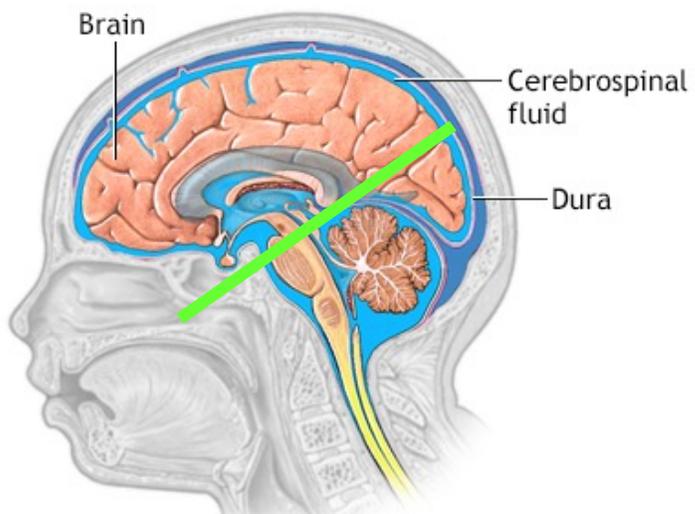


Image Spectrale

Composante 1

Offset

Width

Seuil 32

Fourier

definir

aliasing 0%

0 640

Phase -1

LCS

SANG

toler_Phase 3

Sauvegarder

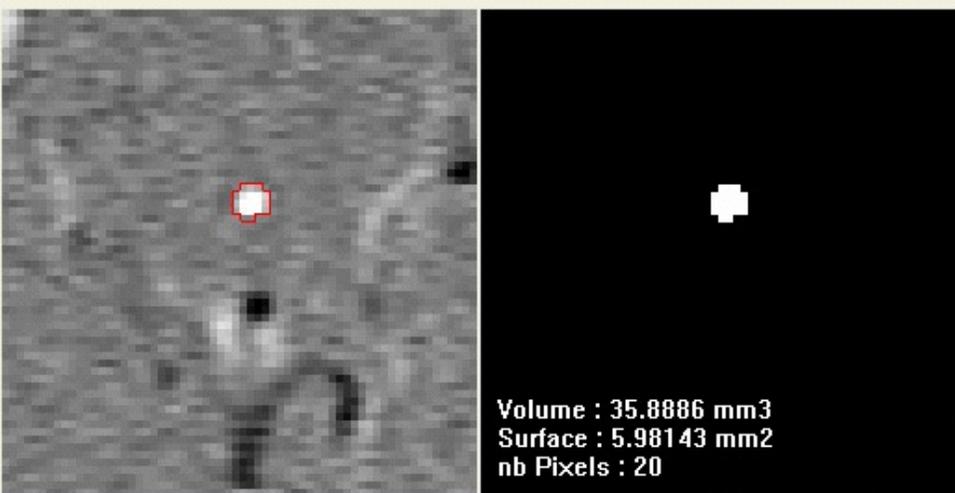
Images

graph : Graph Vit Surf

anim3D : 3D FLUX

mag mask : Mag_mask=1

i-confiance : 5



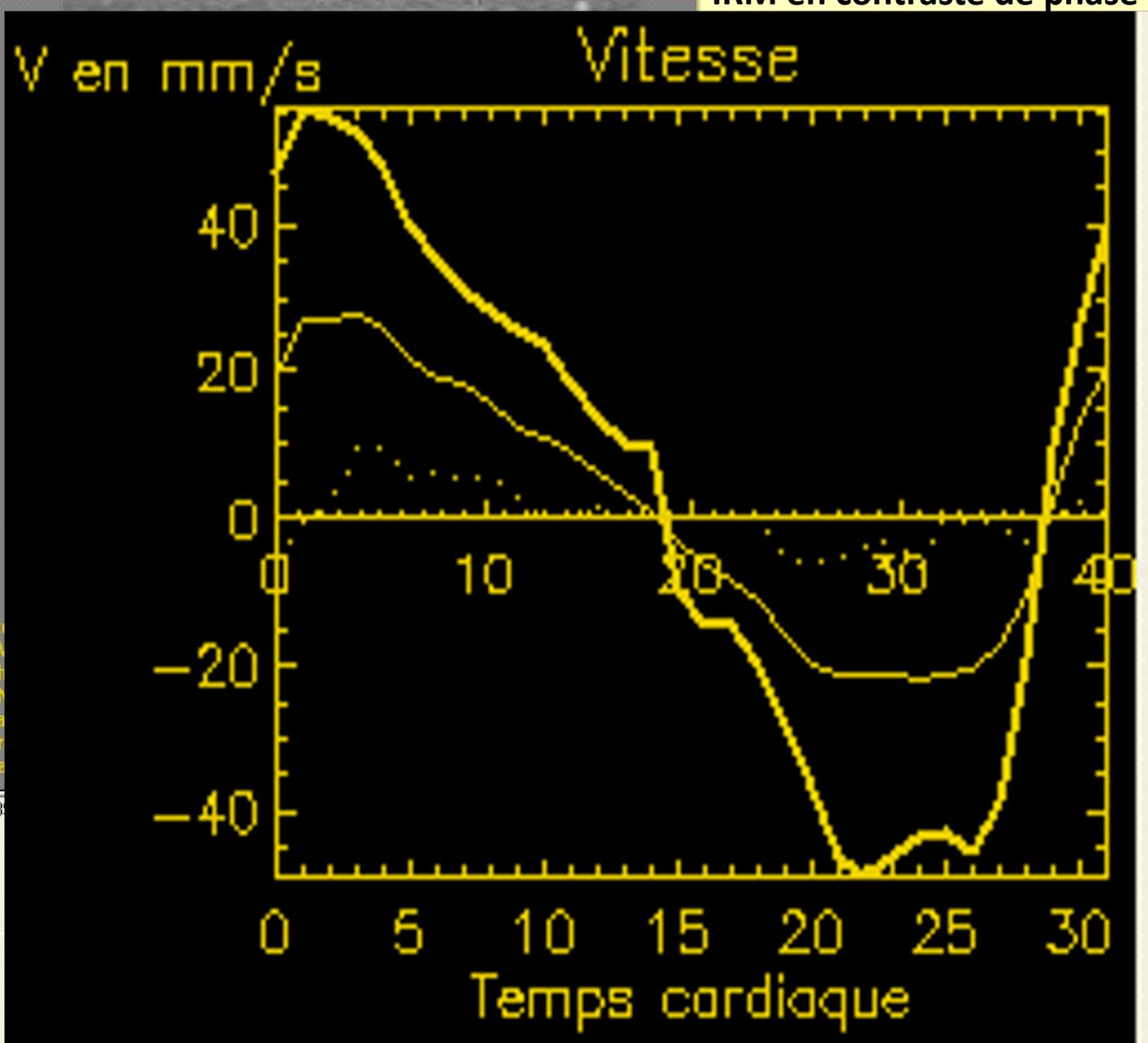
Debit : 11.3639 mm³ / sec
 Debit : 0.981837 l / jour

V en mm/s

Vitesse

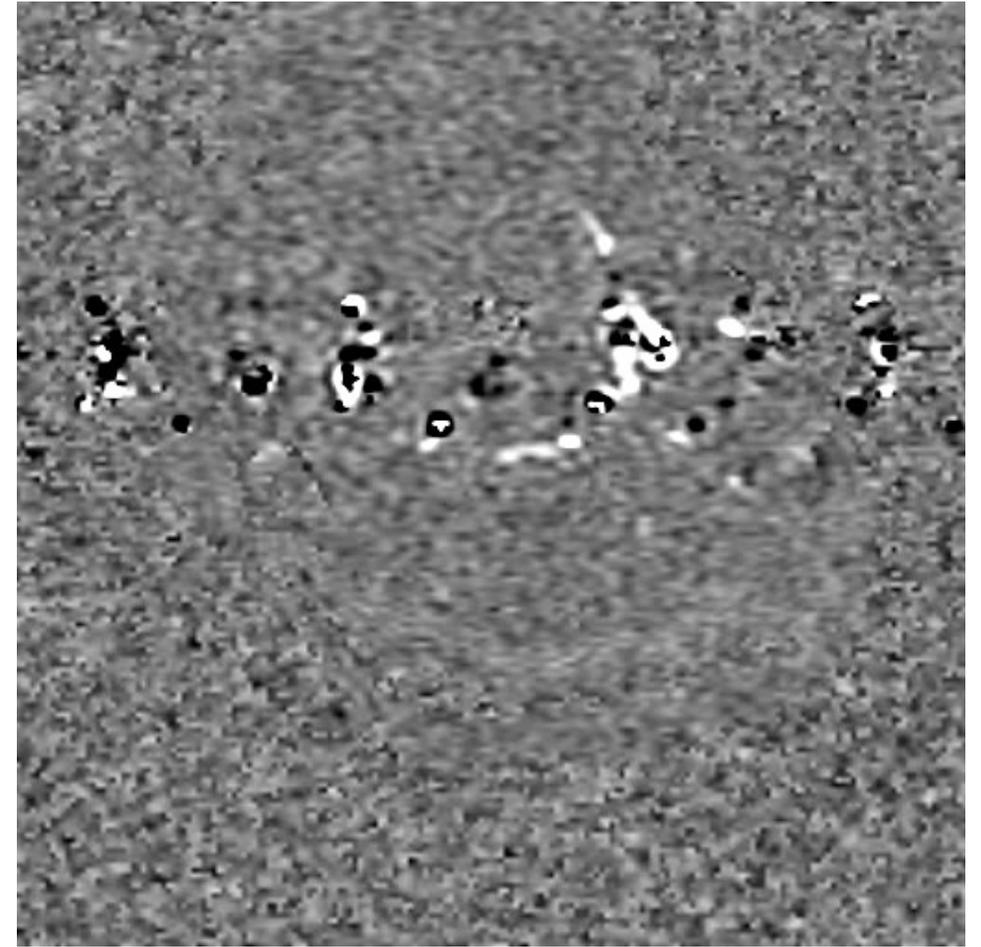
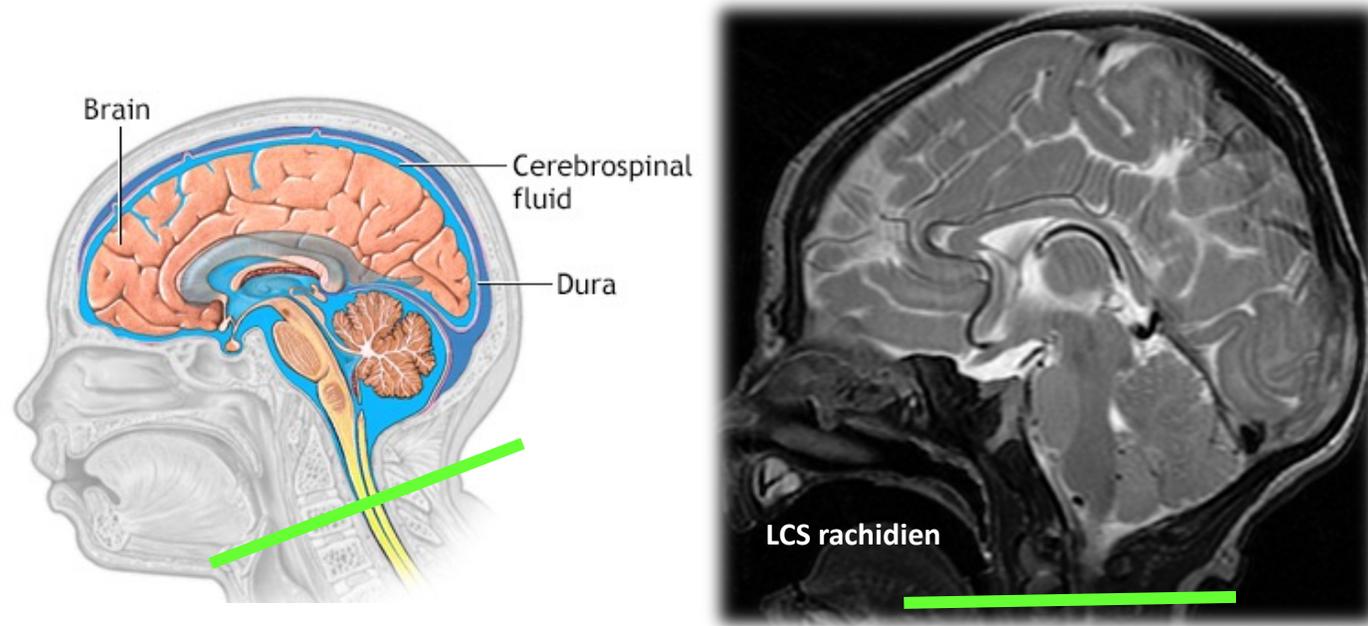
Temps cardiaque

R_moy : 1.27614 EVALUATION BRU



Acquisition des images : le LCS

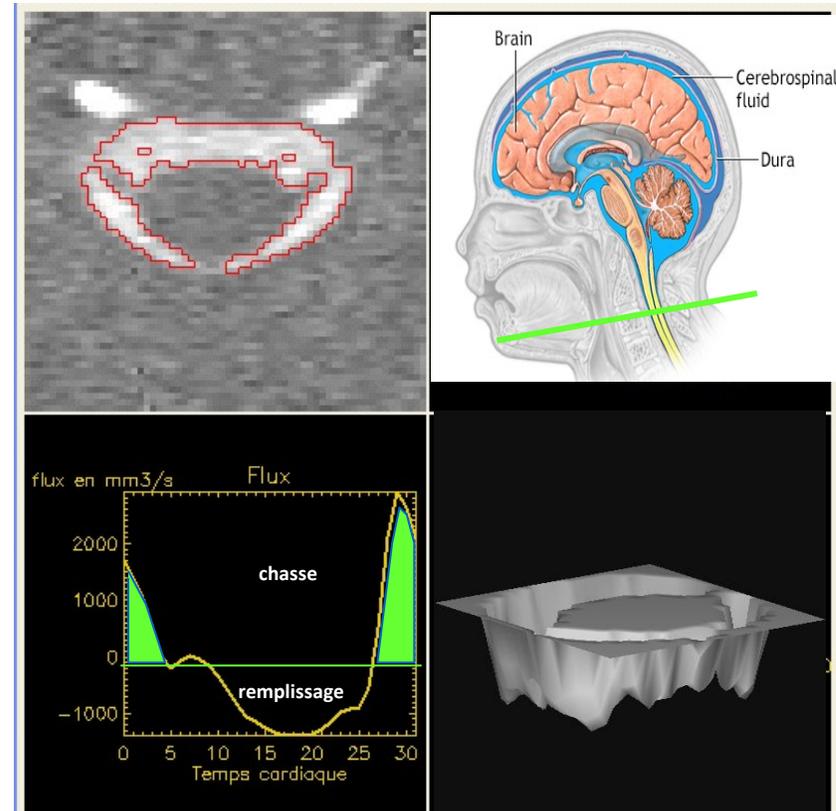
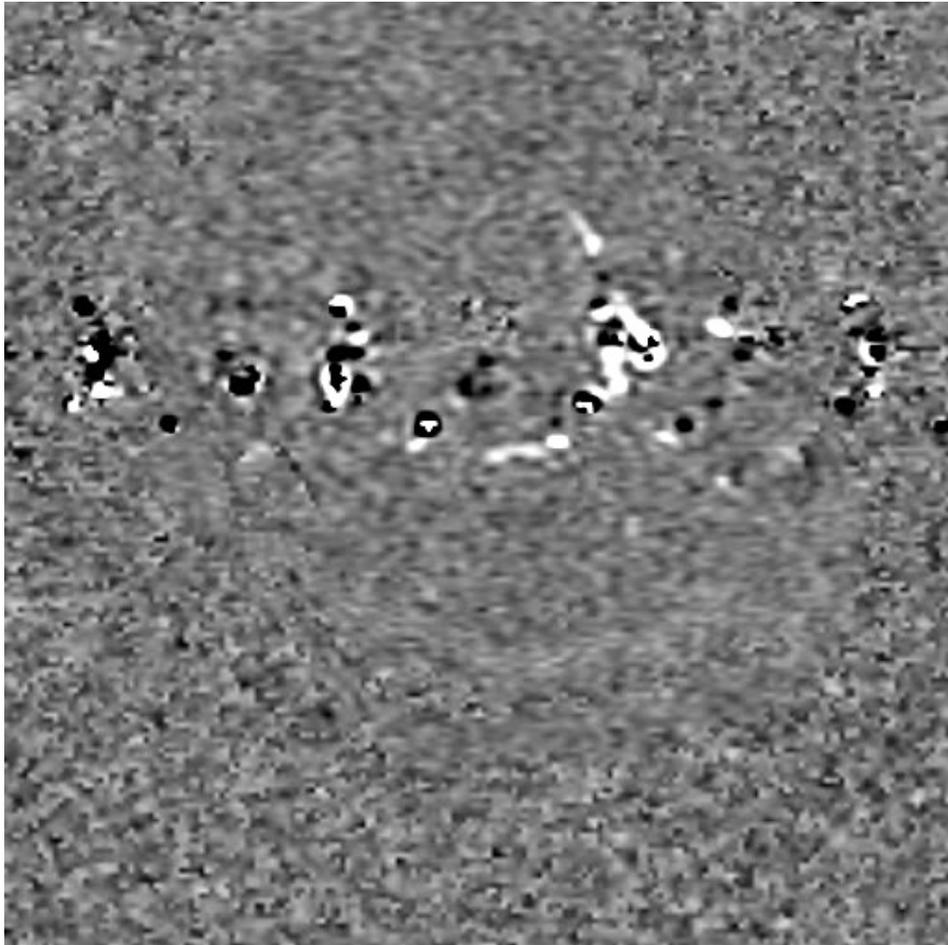
Positionnement de la coupe dans l'aqueduc de Sylvius chez un nourrisson âgé d'une semaine.

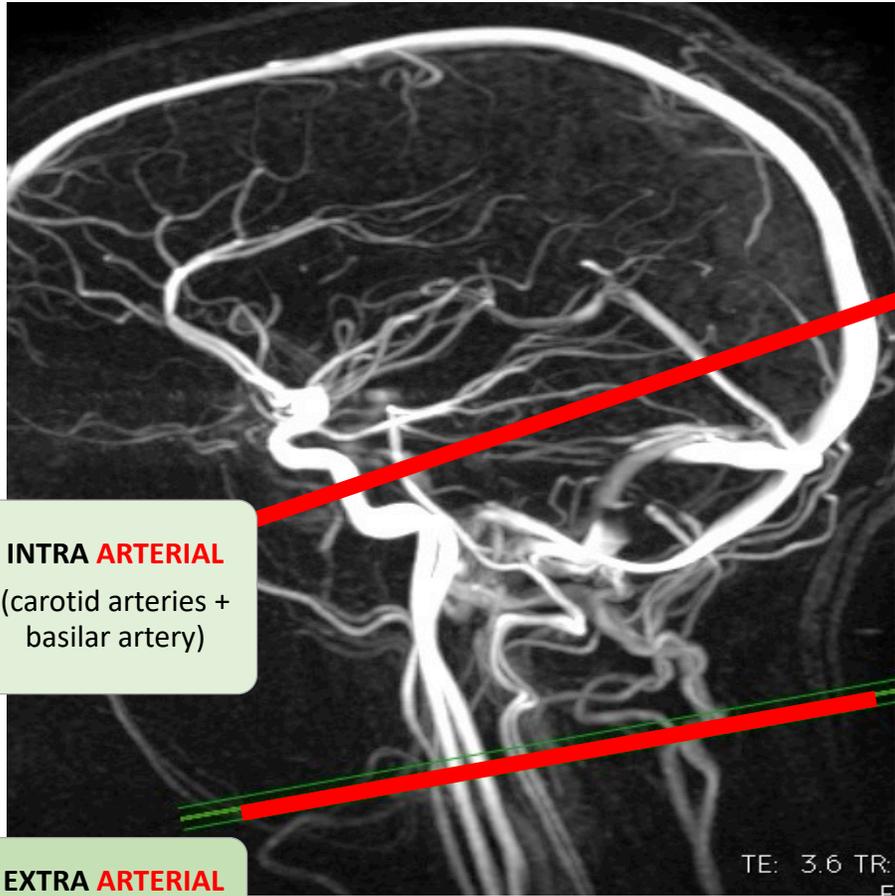


IRM en contraste de phase

Flux du LCS

Volume oscillatoire du LCS ou STROKE VOLUME



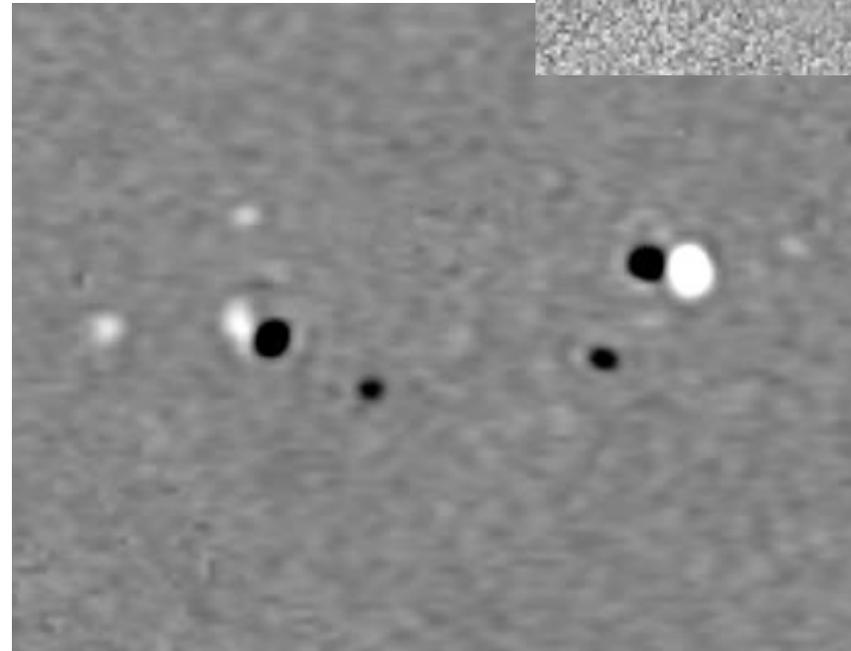
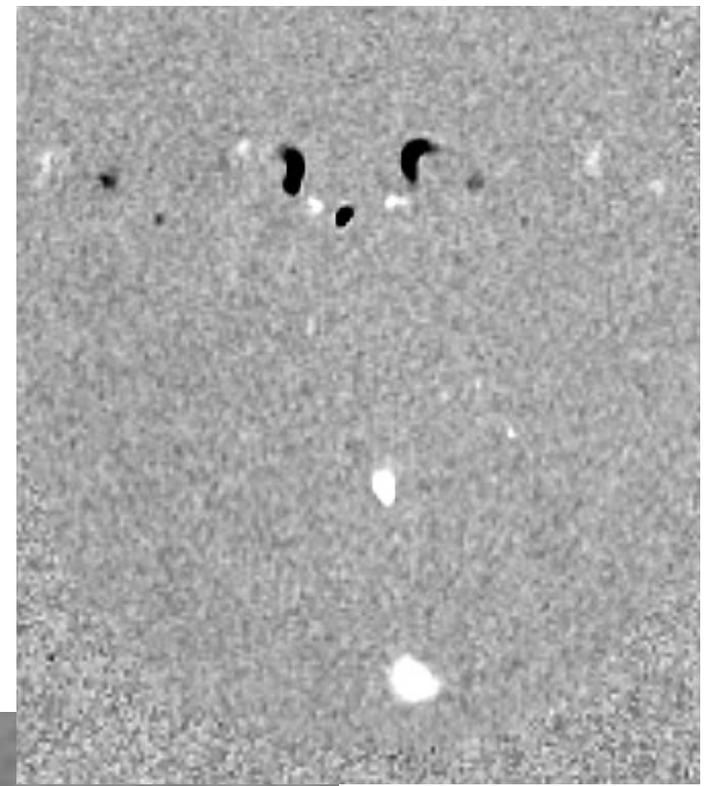


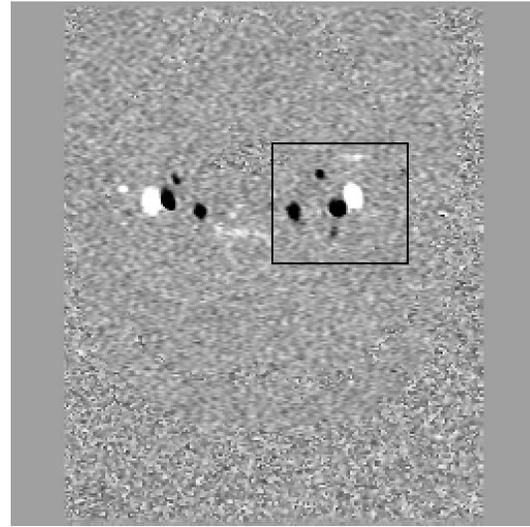
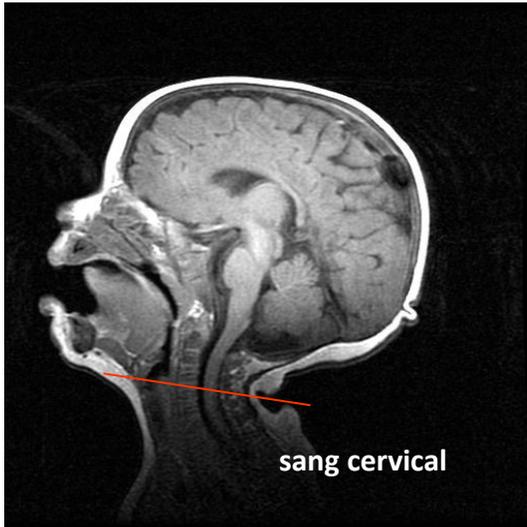
INTRA ARTERIAL
(carotid arteries +
basilar artery)

EXTRA ARTERIAL
(internal carotid
arteries +
vertebral arteries)

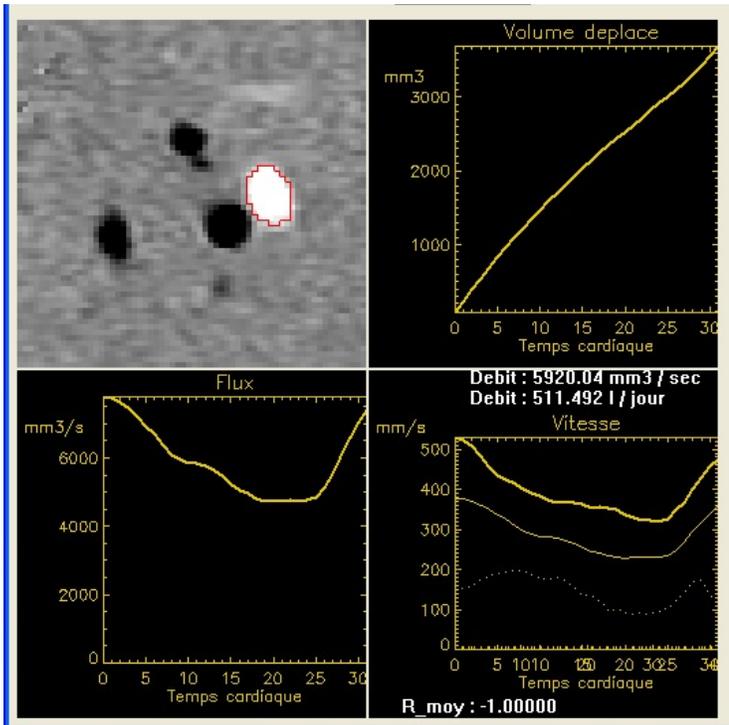
INTRA VENOUS
(straight sinus +
sagittal sinus)

EXTRA VENOUS
(jugular veins)

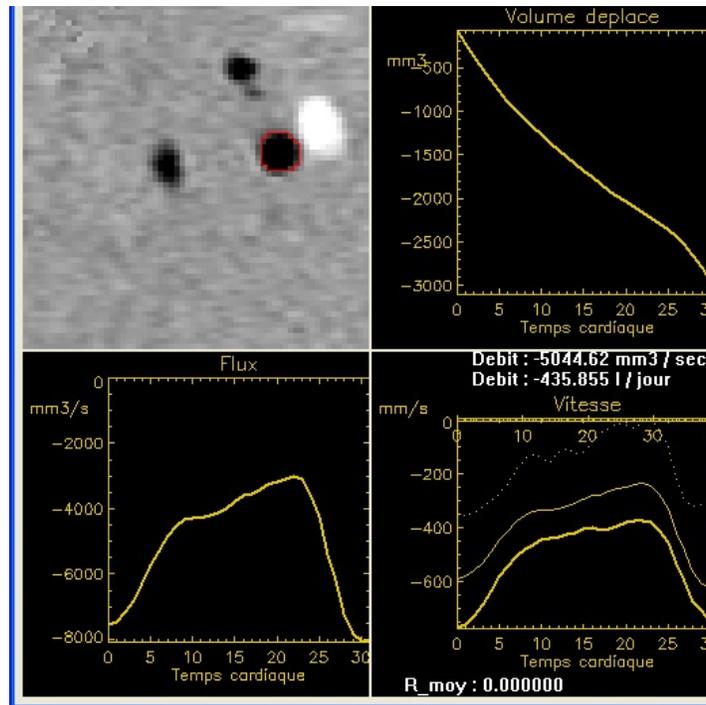




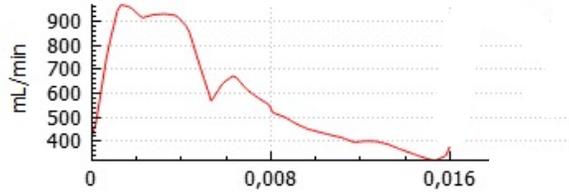
Segmentation de la jugulaire gauche



Segmentation de la carotide interne gauche

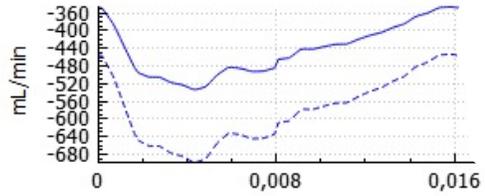


Cerebral arterial blood flows

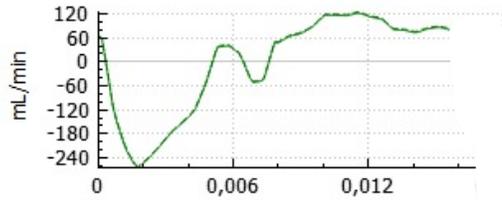


Cerebral sinuses blood flows

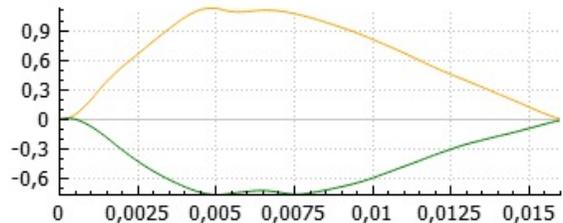
Venous correction = 1.31



Spinal CSF flows



Cerebral blood volume change



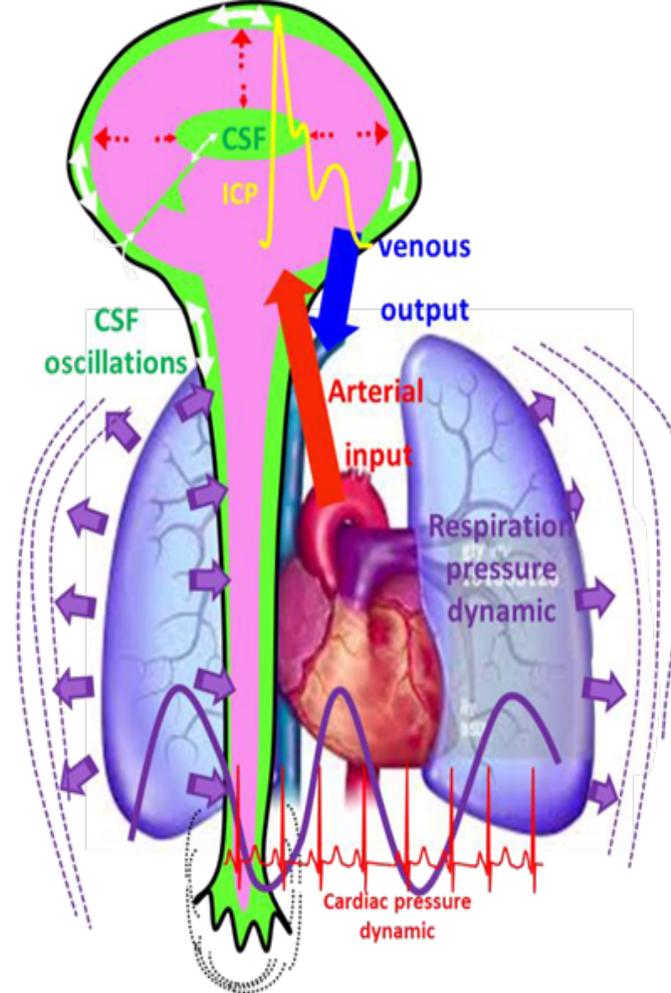
Min volume = 0.0 mL

Max volume = 1.1 mL

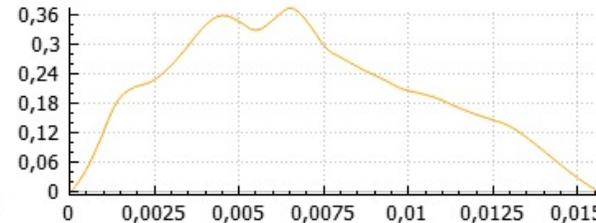
Mean volume = 0.7 mL

Volume amplitude = 1.1 mL

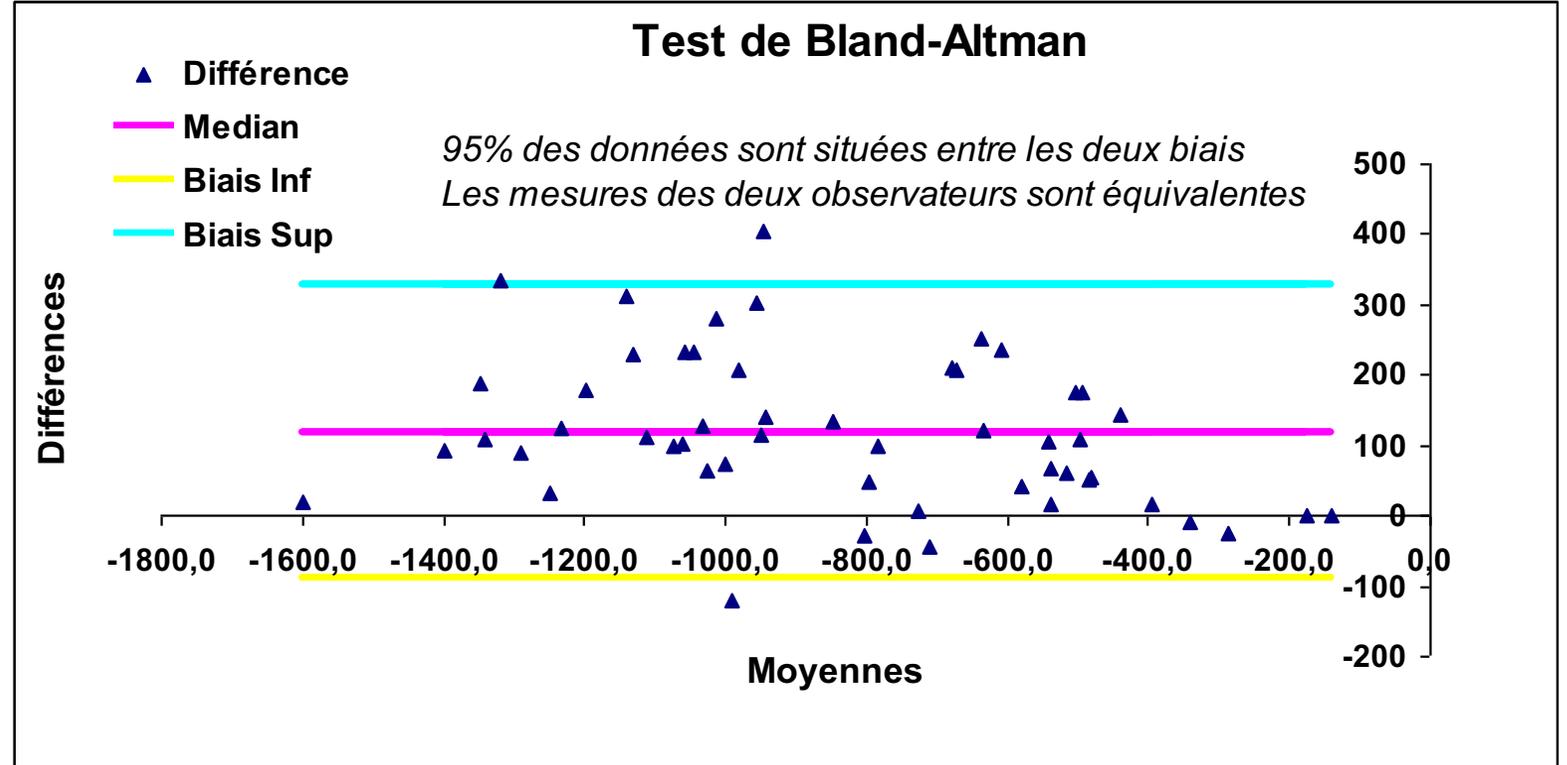
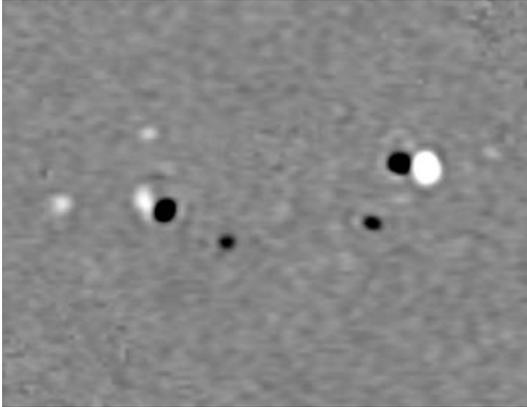
CSF blood volume change



CSF and blood volume change



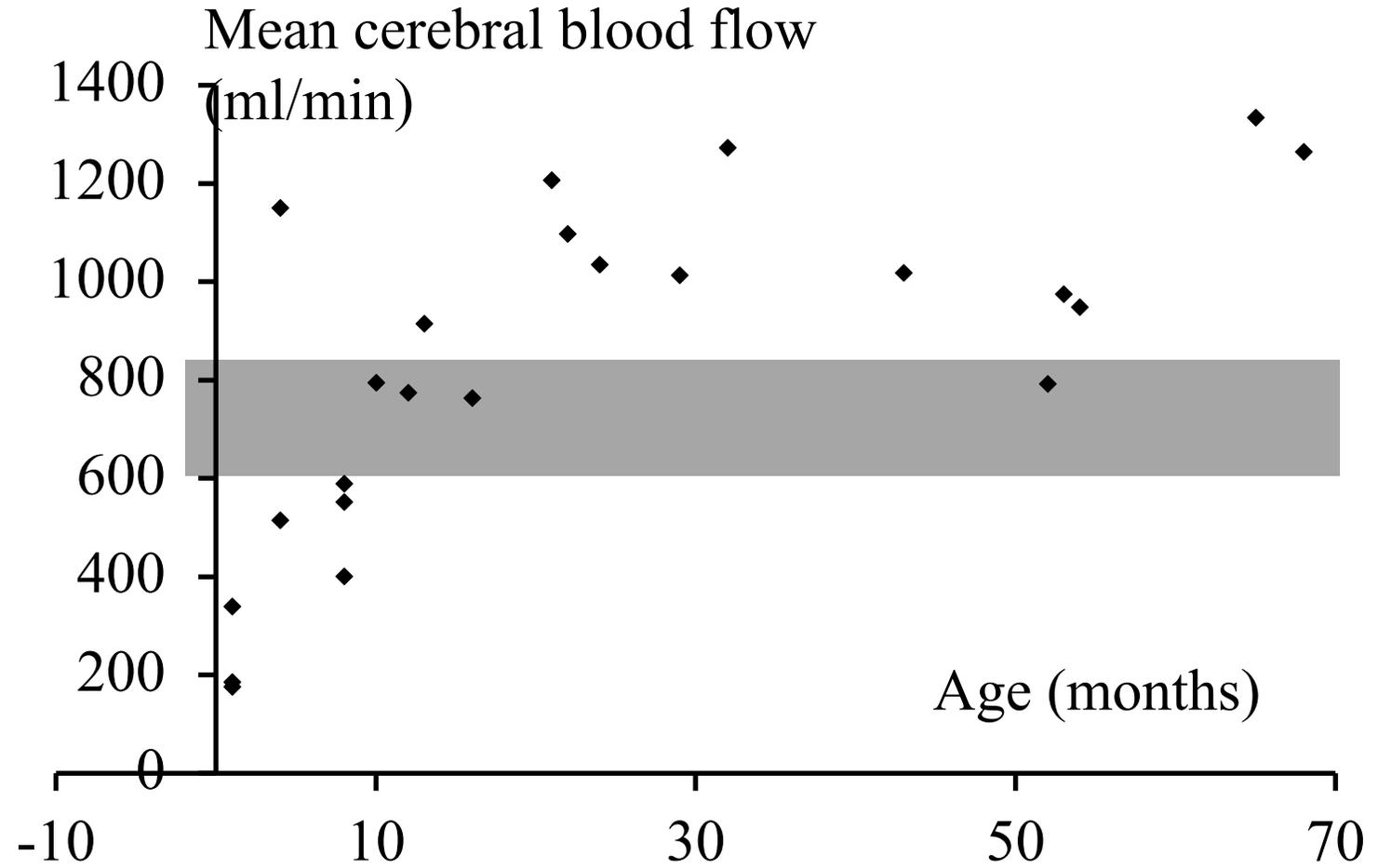
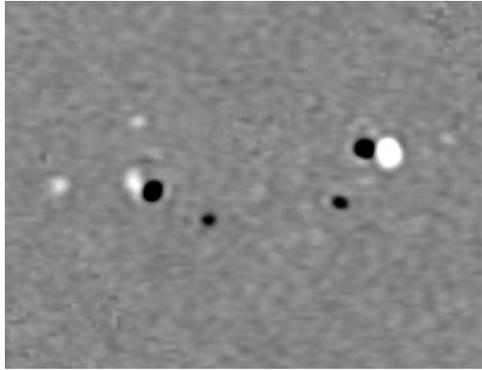
RESULTS Control Group



test de Bland-Altman montrant une bonne reproductibilité du logiciel et des traitements réalisés par deux observateurs.

Le test a été réalisé sur la comparaison des 36 débits artériels cérébraux obtenu en sommant les (CID+CIG+VD+VG).

RESULTS Control Group

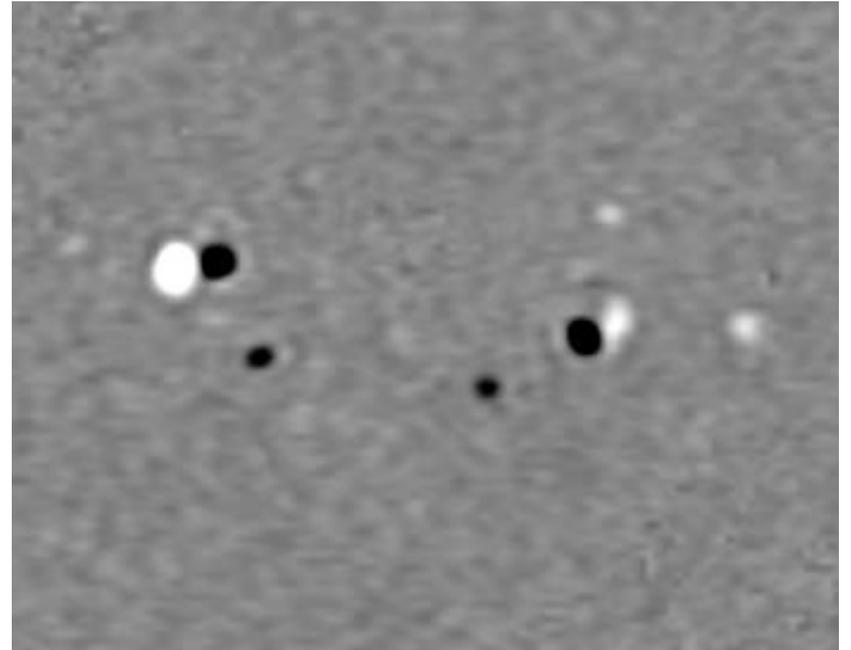


In the control population, the mean cerebral blood flow increased with age.

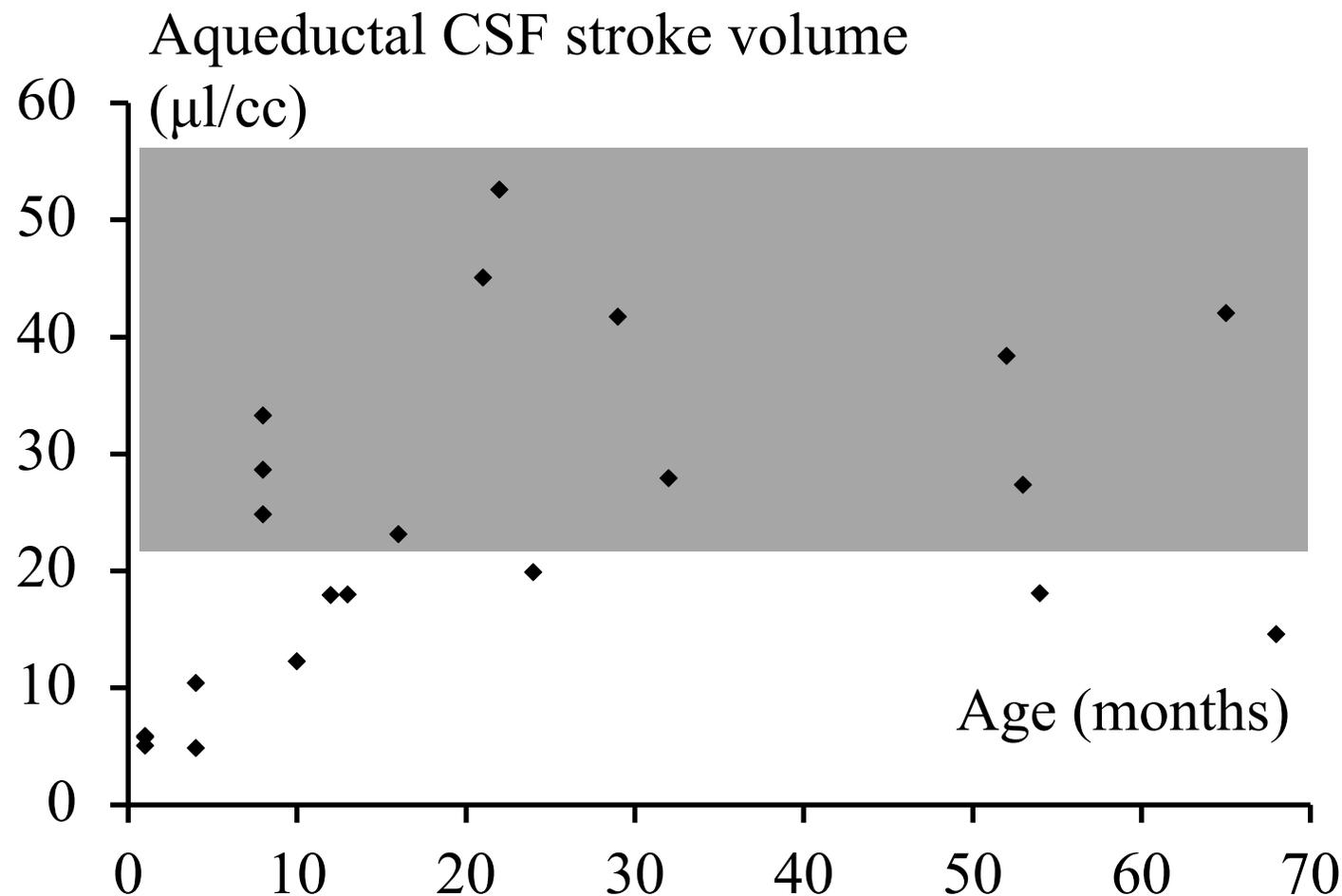
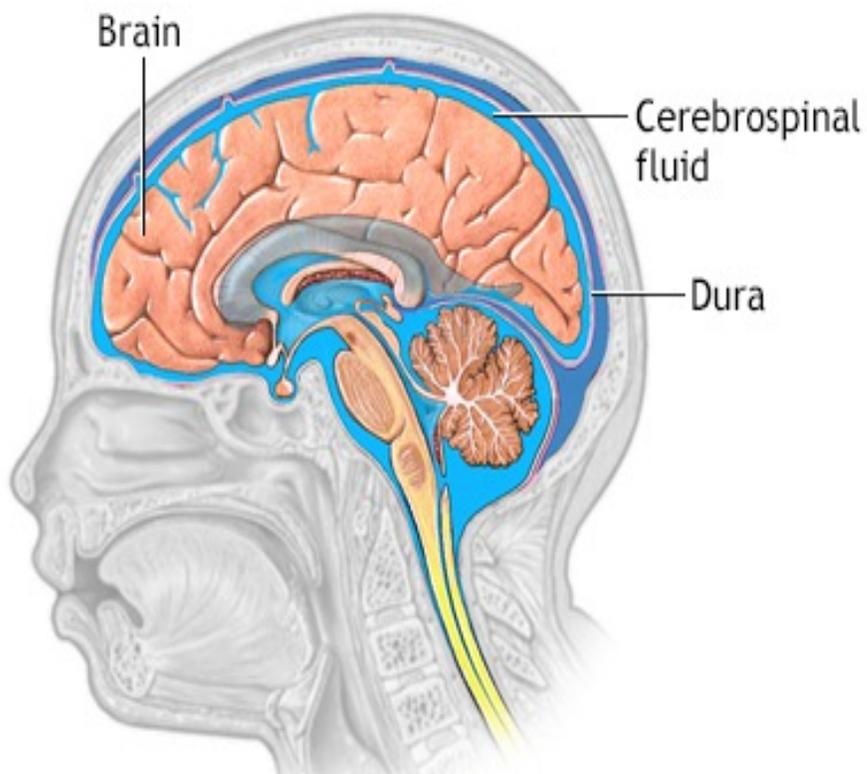
RESULTS Control Group

Le débit dans la jugulaire droite est prédominant par rapport a la gauche ($p < 0,05$)

Les débit dans la CID ne sont statistiquement pas différents de la CIG ($p < 0,001$)

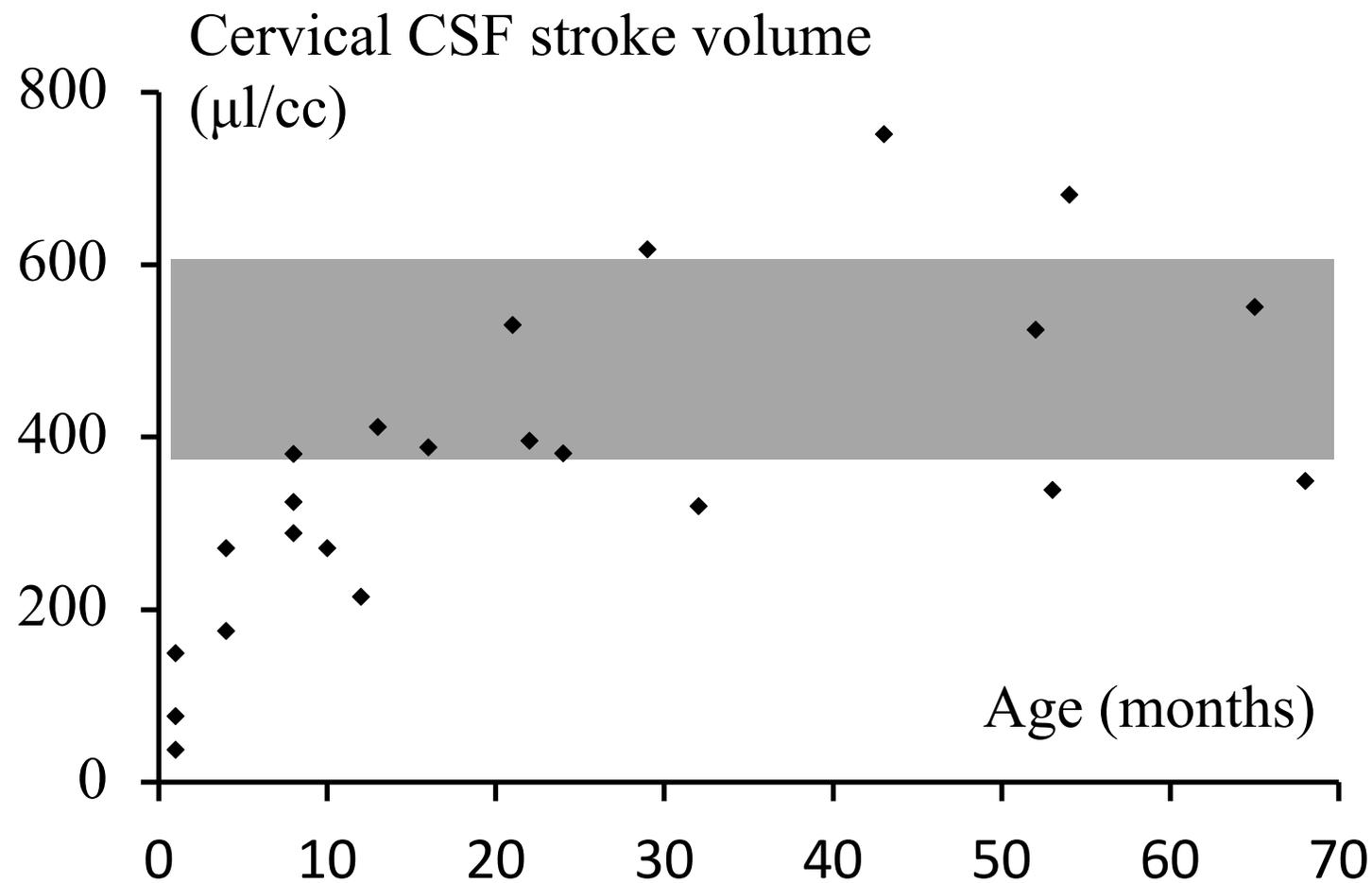
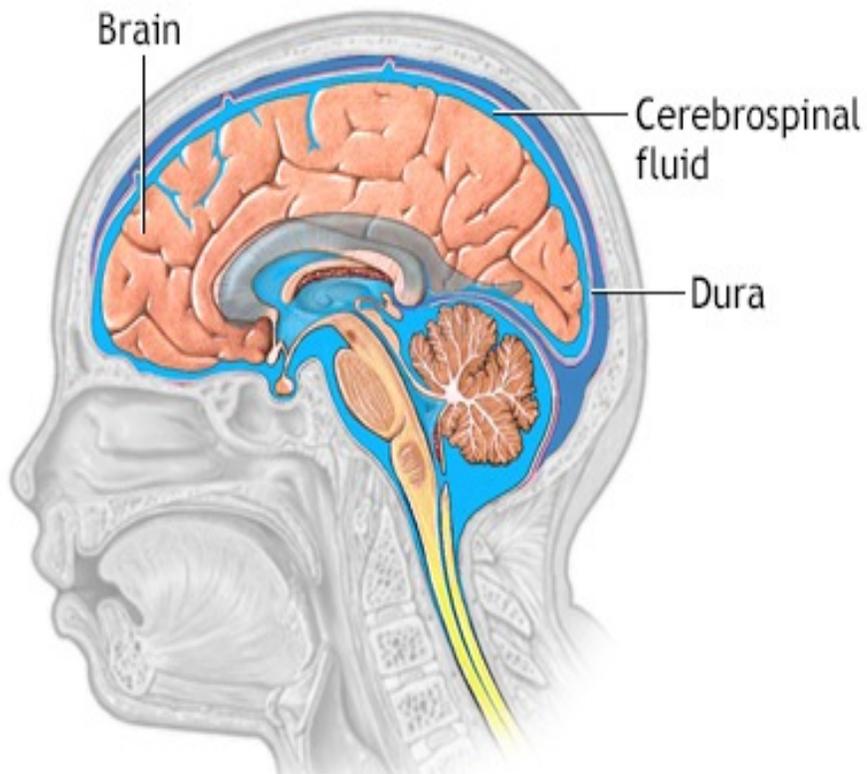


RESULTS Control Group



In the control population, aqueductal CSF amplitude oscillations flow increased with age as well as the mean cerebral blood

RESULTS Control Group

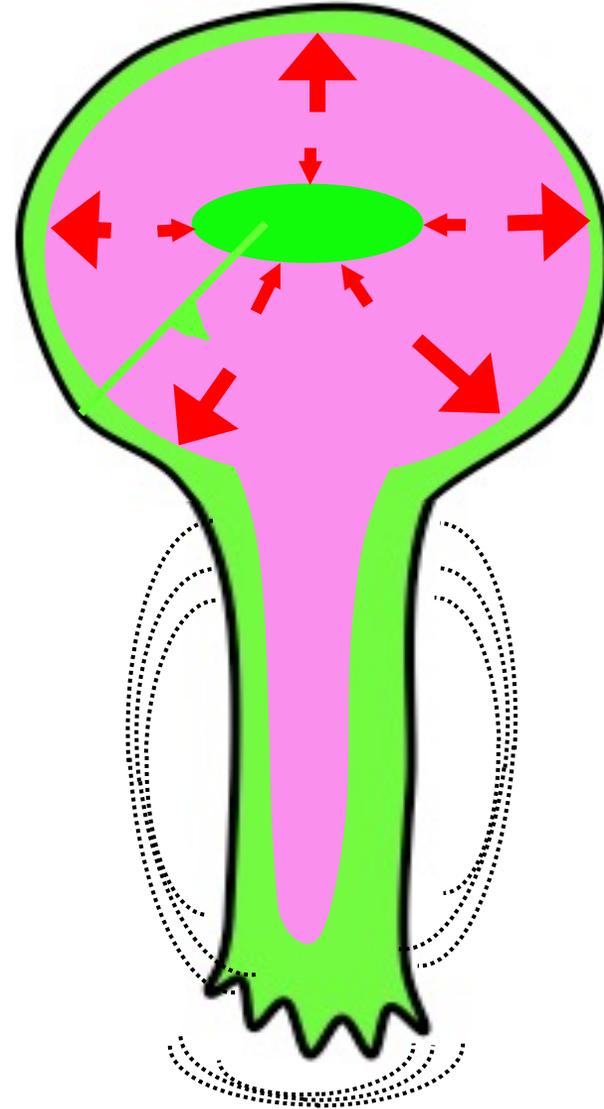


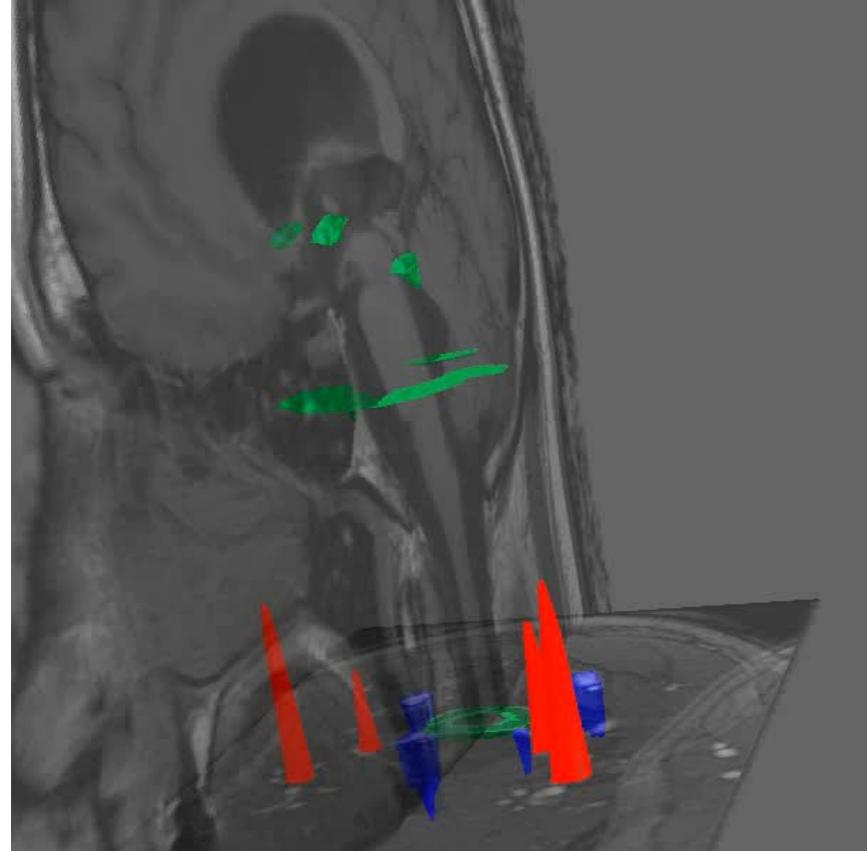
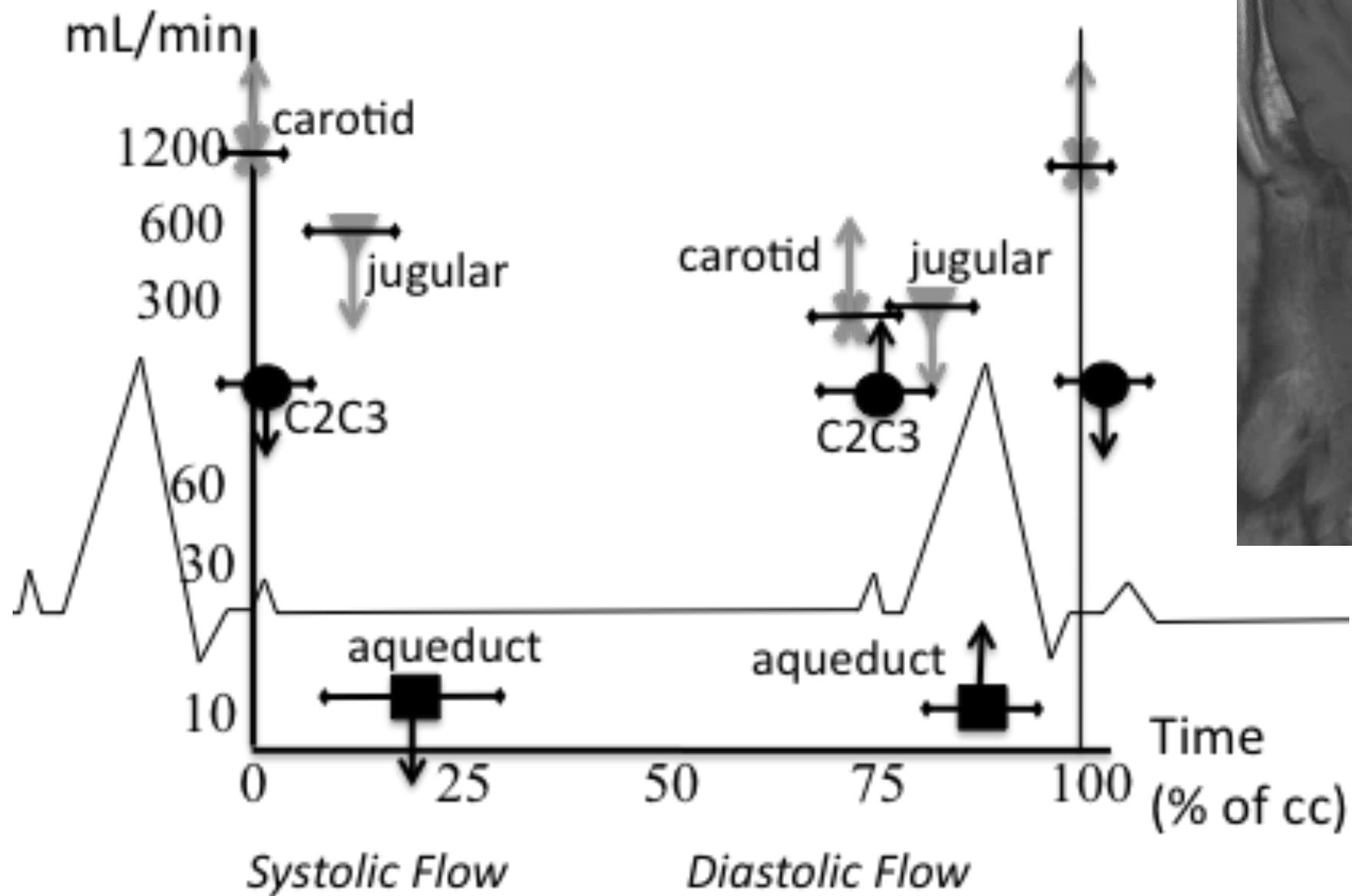
In the control population, cervical CSF amplitude oscillations flow increased with age as well as the mean cerebral blood

Valeurs physiologiques des volumes oscillatoires du LCS

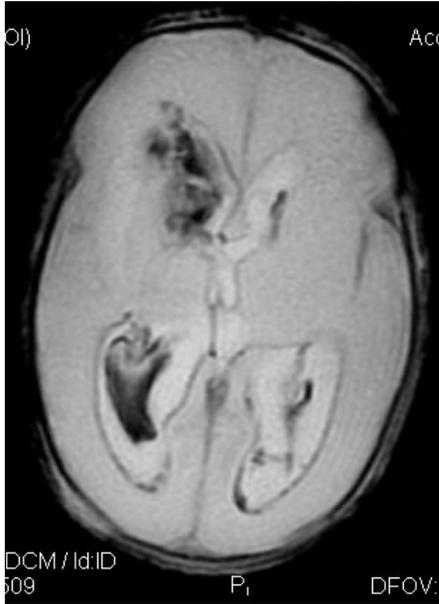
Le volume oscillatoire du LCS des ventricules ne participe qu'à moins de 10% de l'ensemble du volume chassé dans le canal spinal !

L'expansion du volume cérébral se fait principalement vers la périphérie cérébrale en comprimant les Espaces sous arachnoidiens

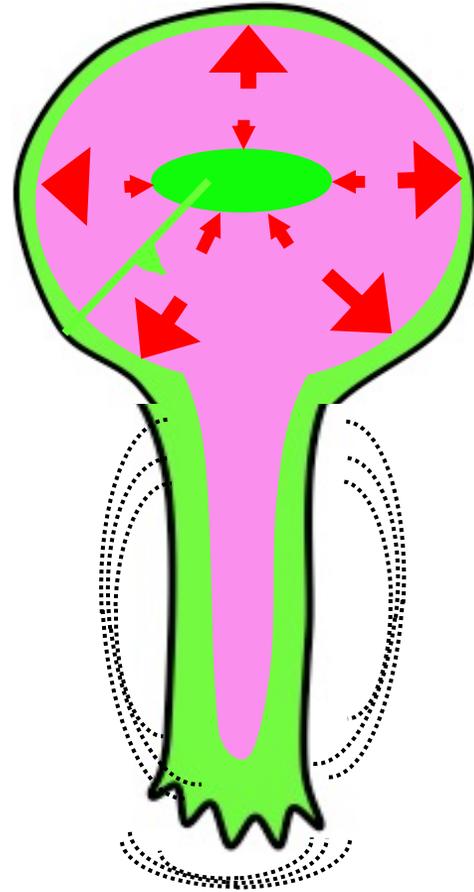




RESULTS IVH Group

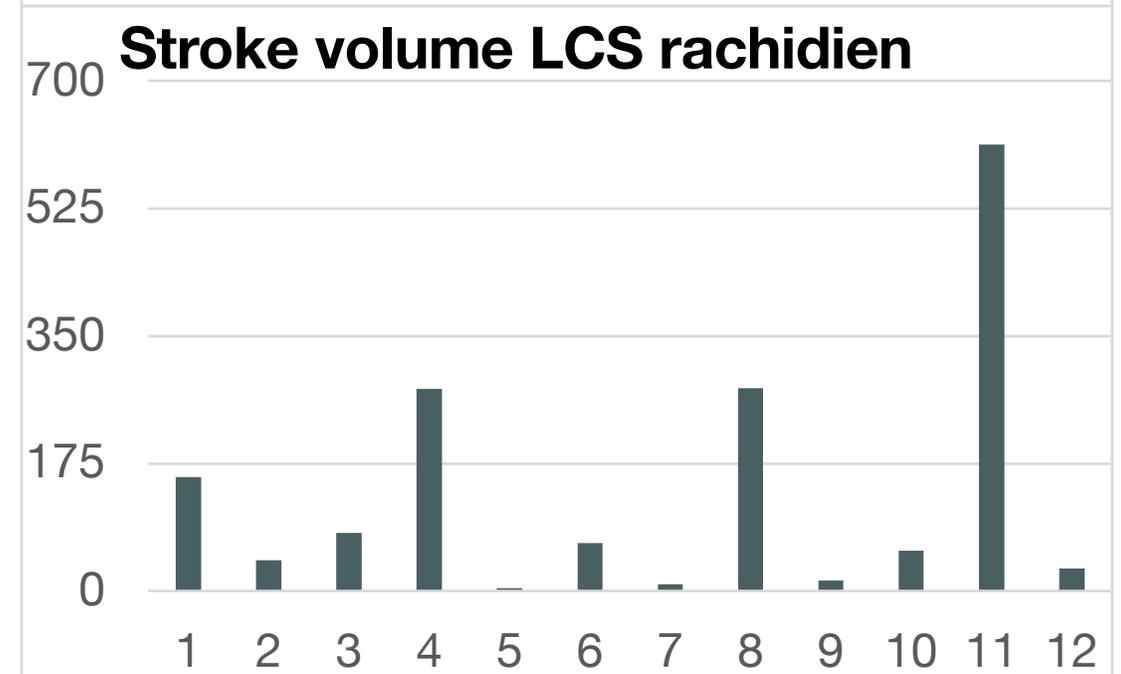
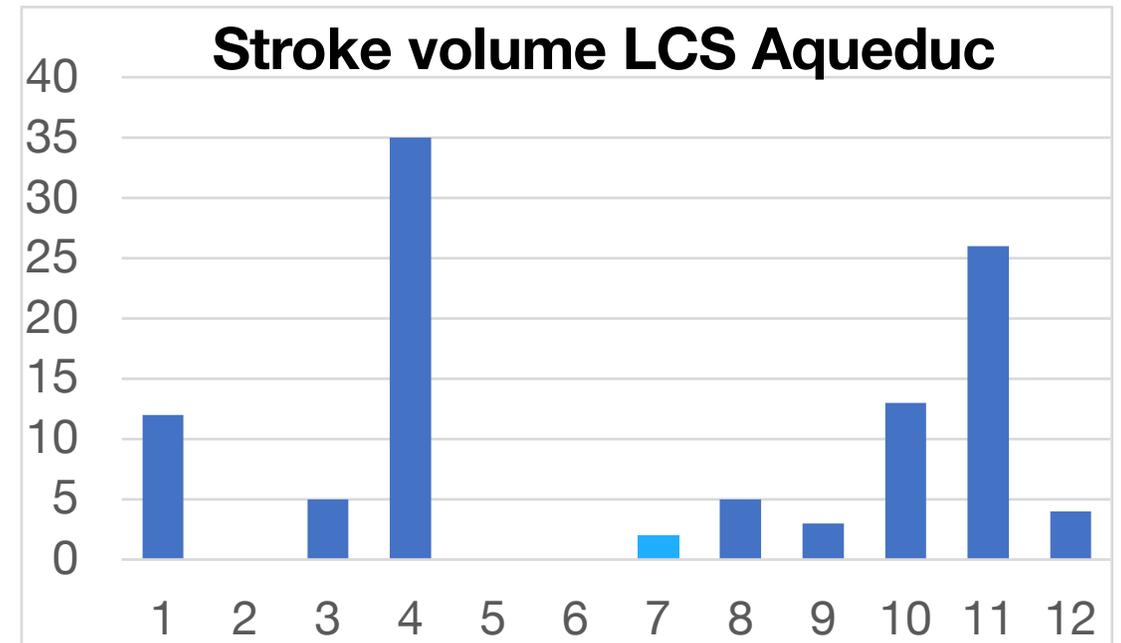


impact of haemorrhage (IVH) newborn populations in cerebral hydrodynamic



No quantitative significance because no reference value from large newborn population

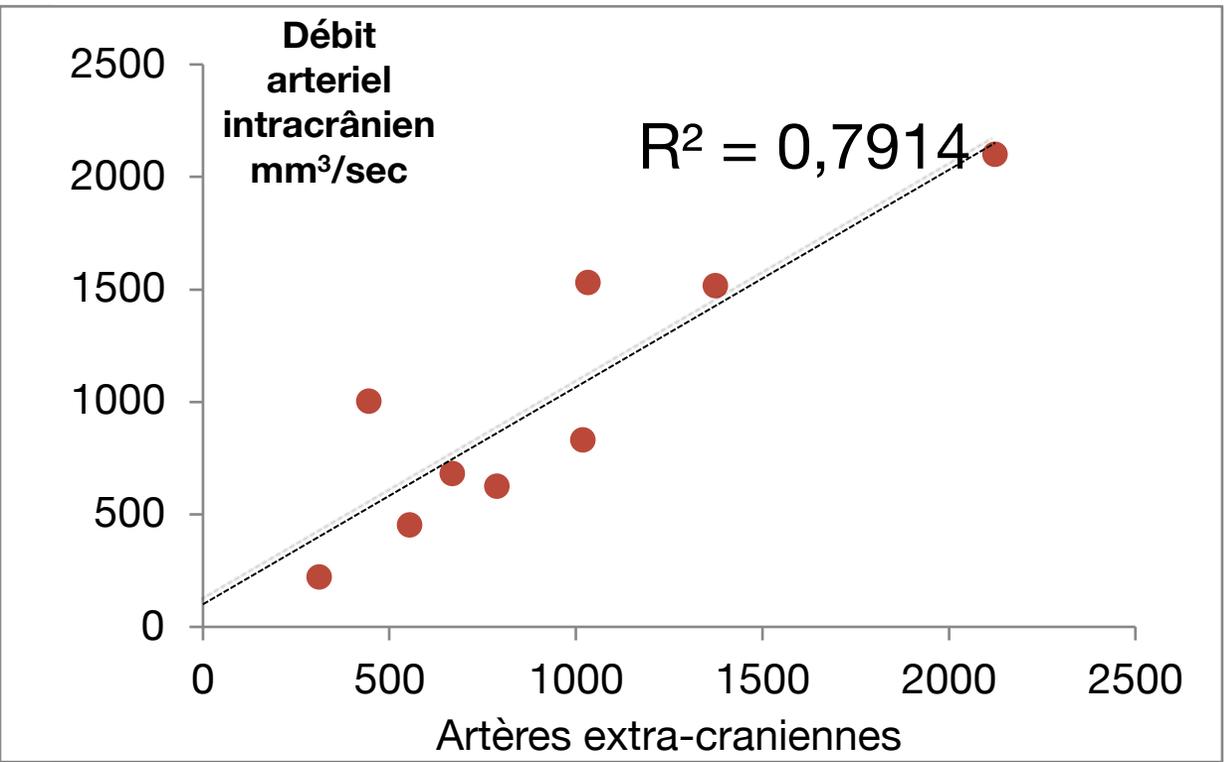
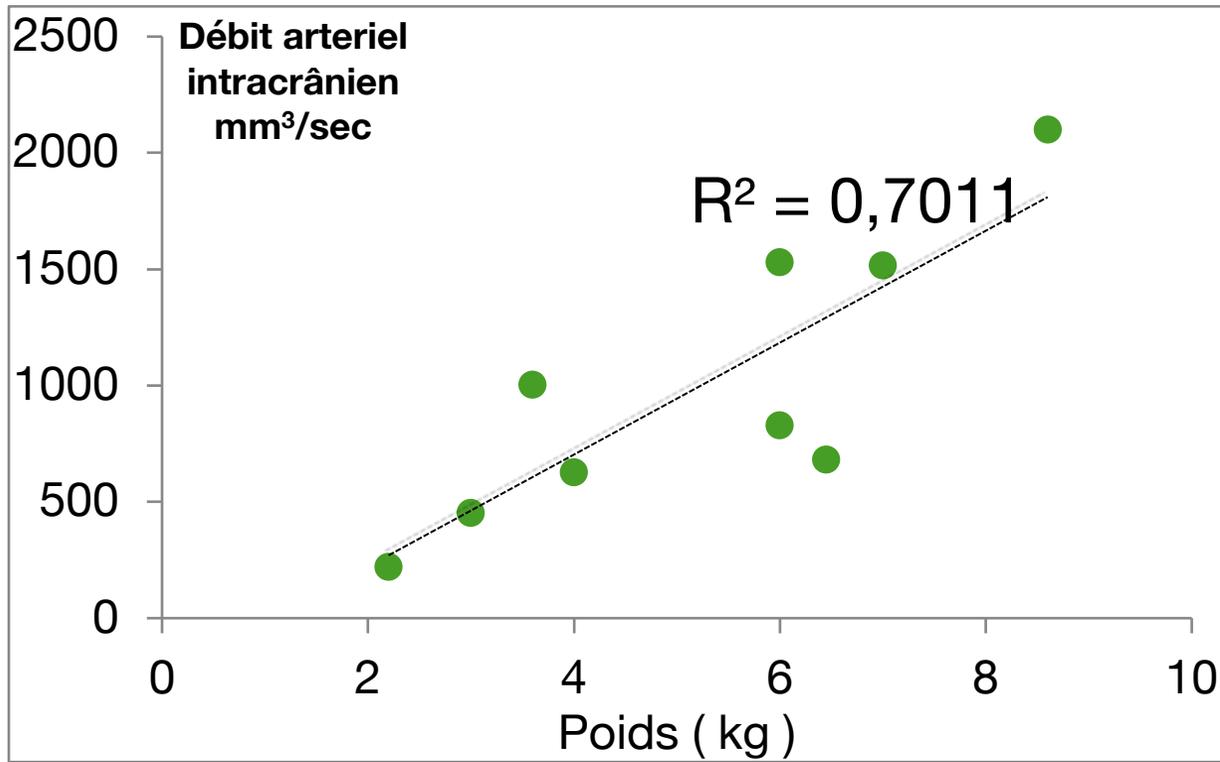
Nevertheless,
In all IVH children, CSF alterations were observed.



RESULTS

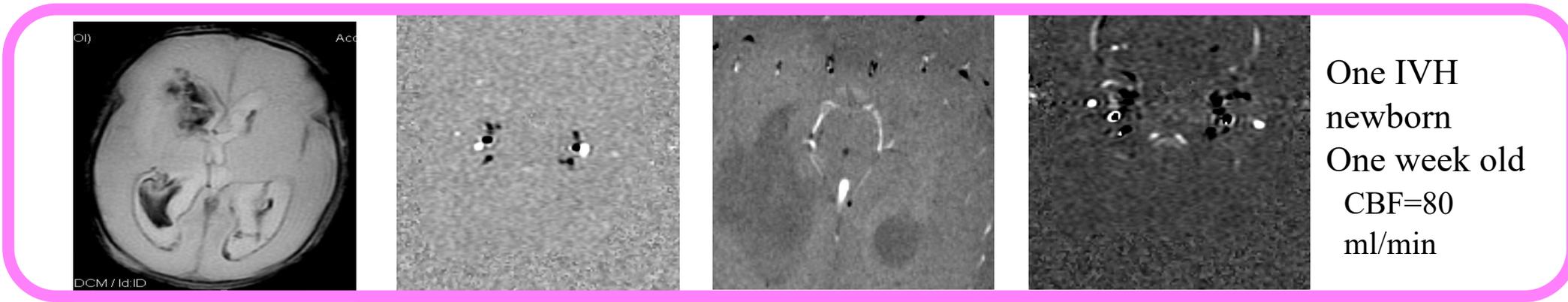
IVH Group

Impact of haemorrhage in cerebral hemo dynamic

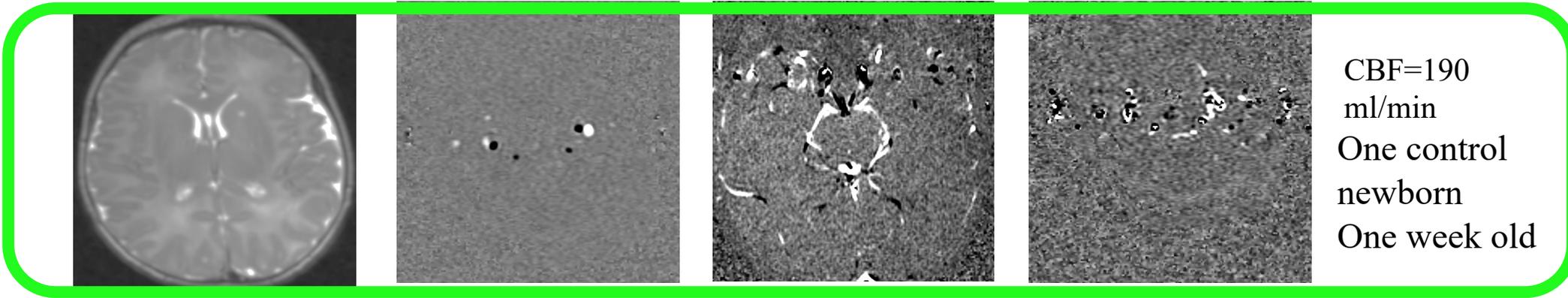


RESULTS

IVH Group

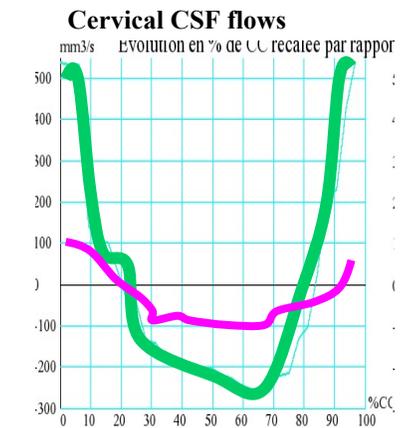
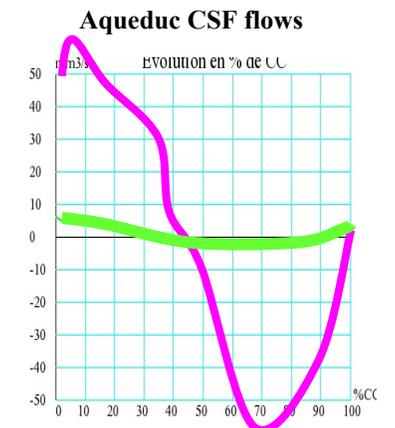
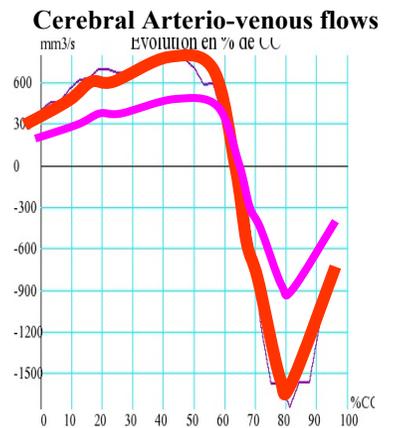


<<<<



Red, Green curves
: control newborn

Pink curves
: IVH newbornx



Discussion

Les flux vasculaires en pédiatrie, et principalement aux premiers âges de la vie, ne sont appréhendés que par l'échographie doppler.

L'hydro hemo dynamique du LCS du nourrisson et du nouveau né est encore peu, voire « pas » étudiée et connue.

L'apport d'un haut champ magnétique de 3 Tesla couplé à une séquence d'imagerie rapide des flux par contraste de phase nous a permis de mettre en place un protocole complet d'investigation des flux vasculaires et du LCS.

Le temps nécessaire à une acquisition complète permettant de quantifier l'ensemble des flux artériels, veineux et du LCS au niveau intra et extra-crâniens est donc de l'ordre de **5 minutes**, ceci ne pénalisant pas la durée globale de l'examen.

Par ailleurs ces séquences n'entraînent pas d'augmentation du SAR.

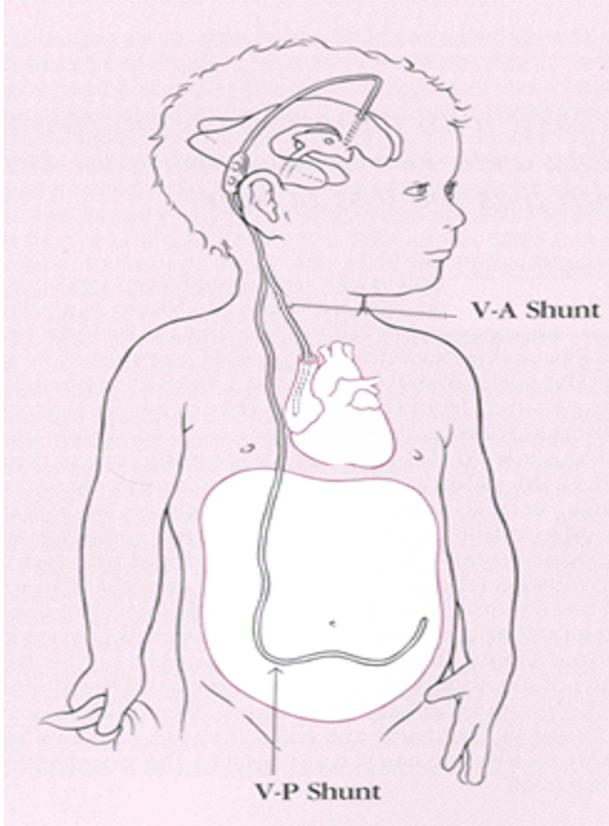
Conclusion :

L'IRM en contraste de phase est utilisable en clinique.

Quantifie la dynamique vasculaire cérébrale et celle du LCS

Une hémorragie peut impacter la dynamique de différentes manières et à différentes localisations anatomiques.

Elle apporte des informations complémentaires à la morphologie utile pour comprendre le dysfonctionnement et aiguiller la prise en charge chirurgicale le cas échéant.



Les néo neuro spins s'écoulent aussi ... plus ou moins bien !

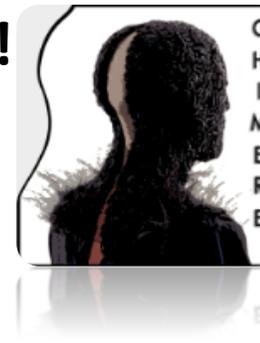
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Radiology department, University hospital, Amiens, France.

Neurosurgery department, University hospital, Amiens, France.

Image processing department, University hospital, Amiens, France.



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Unité de traitement de l'image médicale du CHU Amiens.

