CSF and cerebral blood flows in paediatric: Evaluation with Phase contrast MRI

O. balédent[1], V. Courtois[2], B. Krepjowicz[2], J. Schauvliege[3], A. Fichten[4], G. kongolo[5], R. bouzerar[1], and C. Gondry-jouet[3]
[1]image processing, university hospital, Amiens, Picardie, France, Metropolitan, [2]Ecole supérieure d'ostéopathie et de biomécanique, Paris, [3]radiology, university hospital, Amiens, Picardie, France, Metropolitan, [4]image processing, neurosurgery, Amiens, Picardie, France, Metropolitan, [5]pediatry, university hospital, Amiens, Picardie, France, Metropolitan

Introduction:
Ventricular enlargement in paediatric subject is atrophic or obstructive. In adults, Phase contrast MRI (PCMRI) is used to quantify cerebral hydrodynamics and to classify patients with flows' alterations. The purpose of this study is to describe the pattern of normal CSF and cerebral vascular flows in a paediatric population and to demonstrate how altered flows can be pointed up in children with hydrocephalus.

Methods:
Thirty six (5 days- 8 years) children, who underwent cerebral MRI for neurological dysfunctions without radiological evidence of brain injury, were included in the paediatric control group. The second group consisted of 6 newborns (9 days-6 weeks) suffering from ventricular dilation associated with intra-ventricular haemorrhage (IVH). Aqueductal (Venc=5-20 cm/sec) and cervical (venc=5-10 cm/sec) CSF oscillations, internal carotid arteries and venous cerebral blood (Venc=80-100 cm/sec) flows were measured using fast PC-MRI protocol under 3 Tesla scanner. Coils: depended on the newborn age (SAR !!! Knee coil (E/R) 6KW <1 month, Knee coil (E/R) 6KW <1 month, HDbrain PA/R 35KW >10Kg parallel imaging) ; 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 on the foot); slice thickness : 5 mm. Post processing step was performed by two observers using homemade software. PC-MRI sequences added nearly 10 minutes to the total examination duration.

Results:
In the control population, mean cerebral input and output blood flows as well as cervical and aqueductal CSF amplitude oscillations increased with postnatal age (figure 1). Mean aqueductal CSF oscillations represented only 10% of the cervical oscillations.
In all IVH children, CSF alterations were observed. 4/6 patients presented with hypodynamic cervical CSF oscillations. 3/6 presented with hyperdynamic aqueductal oscillations, and 1/6 with aqueductal CSF obstruction.

Discussion:
Using 3 Tesla MRI, paediatric cerebral hydrodynamics study is possible with short time acquisition and sufficient spatial resolution to measure flow in small structures such as aqueduct of Sylvius. Nevertheless, partial volume effects may lower the accuracy of measurements. Because acquisition and post-processing steps are fixed for all exams, the obtained reference values were sufficiently informative to establish if CSF and blood flows were pathologic. In the whole IVH newborns, CSF and blood flows alterations were observed without any doubt. **Conclusion:** As in adult populations, PC-MRI is a useful complementary tool to routine MR exam in the evaluation of paediatric hydrocephalus and can help in the choice between Endoscopic third ventriculocisternostomy or shunting when surgery is required.

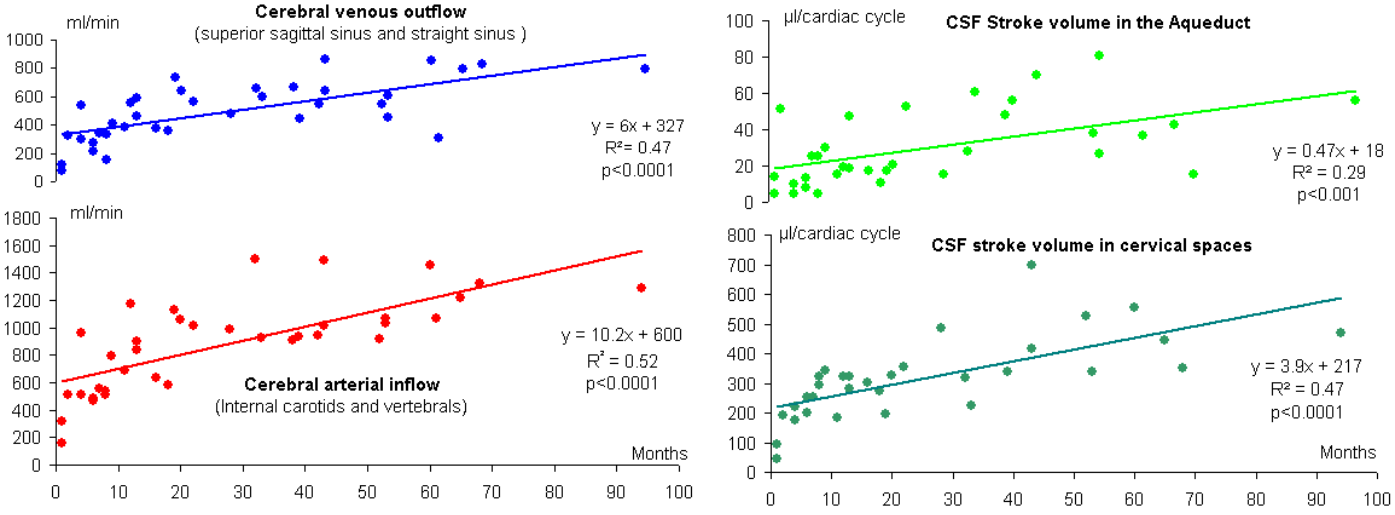

Figure 1: Intracranial hydrodynamics'evolution in a paediatric control population. Mean Arterial and Venous flows during a cardiac cycle and cervical and aqueductal CSF stroke volumes are represented as a function of age.