

FLOW MEASUREMENTS AND EVANS INDEX IN NORMAL PRESSURE HYDROCEPHALUS AND WHITE MATTER LESIONS

E. Arana¹, J. Forner¹, Y. N. Florez-Ordoñez², L. Martí-Bonmatí^{1,3}, D. Moratal², and J. Millet²

¹Radiology, Hospital Quirón, Valencia, Valencia, Spain, ²Grupo BET (Bioingeniería, Electrónica y Telemedicina), Universidad Politécnica de Valencia, Valencia, Spain, ³Radiology, Hospital Universitario Dr Peset, Valencia, Spain

FLOW MEASUREMENTS AND EVANS INDEX IN NORMAL PRESSURE HYDROCEPHALUS AND WHITE MATTER LESIONS

PURPOSE

To compare quantitative analysis of cerebrospinal fluid flow (CSF) of the aqueduct of Sylvius using phase-contrast magnetic resonance imaging (PC-MRI) and Evans index. Comparison performed to differentiate patients with idiopathic normal pressure hydrocephalus (NPH), white-matter lesions (WML) and healthy subjects.

MATERIAL AND METHODS

We studied 92 subjects (age 57.6 ± 21.3 , mean \pm standard deviation): 45 healthy subjects, 28 with demyelinating hypoxic-ischemic white-matter lesions (WML) and 19 subjects with suspected idiopathic NPH [1]. MR examinations were performed using a 1.5 T scanner with sagittal T1 weighted images, axial PD, T2 and diffusion weighted images and coronal FLAIR weighted images. Phase contrast sequence was obtained axial to the aqueduct of Sylvius: V_{enc} of 20 cm/s, FOV = 160 mm, 3 mm slice thickness, matrix size = 256 x 256, TR = 53 ms, TE = 11 ms, flip angle = 15° and 27 frames per cardiac cycle with peripheral retrospective pulse gating. In order to maximize accuracy the area of the region of interest (ROI) was defined at half the height of the velocity peak. The quantified parameters were: maximum systolic and diastolic velocity, mean velocity, maximum systolic and diastolic flow, mean flow, CSF production and volume per cycle (*stroke volume*) [2]. Evans index, which is the relative ratio of lateral ventricle expansion, was also measured as a classical parameter of NPH on axial images. ANOVA, discriminant analysis and Pearson tests were used.

RESULTS

All measured parameters, except maximum systolic velocity ($p=0.17$), presented a significant difference (ANOVA, $p \leq 0.05$) between controls and patients. Evans index differentiated NPH from healthy subjects but not from WML patients (ANOVA, Scheffé post-hoc, $p=0.001$ and $p=0.63$, respectively). In the discriminant analysis, the two groups (controls and patients) were classified correctly in a 92.1% of the cases using maximum systolic flow and CSF production. Pearson correlation showed a moderate but statistically significant ($p=0.001$) correlation between Evans index and stroke volume (0.53), mean flow (0.54), maximum systolic and diastolic flow (0.59 and 0.53, respectively) [3].

CONCLUSION

Quantification of CSF flow dynamics is more discriminative than Evans index to differentiate NPH patients with hyperdynamic state from control subjects and white-matter lesions.

REFERENCES

- [1] Barkhof E, Kouwenhoven M, Scheltens P, Sprenger M, Algra P, Valk J. Phase-contrast cine MR-imaging of normal aqueductal CSF flow - effect of aging and relation to CSF void on modulus MR. *Acta Radiol* 1994;35:123-30.
- [2] Flórez YN, Moratal D, Forner J, Martí-Bonmatí L, Arana E, Guajardo-Hernández U, et al. Semiautomatic analysis of phase contrast magnetic resonance imaging of cerebrospinal fluid flow through the aqueduct of Sylvius. *Magn Reson Mater Phy* 2006; 19:78-87.
- [3] Meier U, Paris S, Grawe A, Stockheim D, Hajdukova A, Mutze S. Is there a correlation between operative results and change in ventricular volume after shunt placement? A study of 60 cases of idiopathic normal-pressurehydrocephalus. *Neuroradiology*. 2003;45:377-80.