INTRODUCTION

Standard implementation of MR-perfusion imaging, based upon the bolus injection of an exogenous contrast agent, provides various local microcirculation parameters such as cerebral blood flow (CBF in ml/min/100g tissue). The implementation of this technique is not easy in pediatric populations. An alternative technique was developed without the use of exogenous agent: Arterial Spin Labeling (ASL) provides theoretically absolute CBF maps. The goal of our study is to evaluate the relationship between ASL CBF and intracranial arterial inflow measured using phase-contrast sequence and the associated age-related changes in a pediatric population.

METHODS

Patients: Twenty children (3.3+/−2 years old; range: 1-8 y) who underwent MRI exam were retrospectively studied, in agreement with the local ethics board.

Imaging: 2D Cine-PC sequence with cardiac gating at C2-C3 level and 3D-FSE PCASL imaging with spiral acquisition were implemented on a 3T HDx MR Scanner (GE Healthcare, Milwaukee, WI). Acquisition parameters were: Gradient-echo 2D Fast Cine PC: TR 10-18 ms, TE 4-8 ms, 2 View per segment, 1 Nex, FOV 14x10 to 17x14 cm², Slice thickness 5 mm, Matrix 256x128, Venc 80 cm/s. *3D-FSE Pulsed-Continuous ASL : TR 4500 ms, TE 10 ms, FOV 24x24 cm², Slice thickness 4 mm, Spiral trajectory: 512 points-8 arms, TI 1025 ms (<2 years old) 1525 ms (>2 years old).

Data analysis: Cerebral volume index (CVI): calculated as the volume of the reference ellipsoid fitting the brain surface. Head inclination (Angle): angle between the ASL axial sections and the AC-PC plane defined on a sagittal view. Total arterial inflow Qa was obtained by summation of the internal carotids and vertebral arteries flows. Blood flow analysis was performed using a semiautomatic software: arterial inflow Qa (ml/min) was calculated from 32 images covering the cardiac cycle. ASL data analysis was performed using Ready View (GE Advantage Workstation): global mean CBF (ml/min/100g) at midbrain level was measured and then volumic CBF =CBFv= CBFxCVI (ml/min) was calculated.

Statistical analysis: Pearson correlation tests were used.

RESULTS AND DISCUSSION

The ratio (CBFv/Qa) was negatively correlated to the head inclination (r²=0.68, p<0.001). CBFv was strongly correlated to intracranial arterial inflow Qa especially when normalized with the cardiac frequency N ((r²=0.65, p<0.001). An angular correction [cos(Angle)] significantly improve the correlations between the explored parameters. CBF was not significantly correlated with subject's age whereas Qa, CBFv and Qa/N were (r²= 0.1, 0.58 and 0.71, respectively). Various studies showed the variability of ASL measurements under the influence of several parameters such as: labeling efficiency, changes in blood T1, arterial transit time or selection of inversion time TI. In this study, we observed the significant influence of the head position which is a critical parameter in children population especially under anesthesia. The hemodynamic influence is also highlighted through the cardiac frequency.

CONCLUSION

Our study showed the correlation between the global cerebral ASL perfusion and the reference arterial inflow measured using PC-MRI. The influence of the head inclination is not negligible. Owing to the inclusion of a Cine-PC sequence, knowledge of cervical arteries' flow could improve the accuracy of ASL data.

REFERENCES

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