Brain perfusion patterns: Consistency and similarity with fMRI resting state networks and arterial vascular territories

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Background

Independent component analysis (ICA)[1] is a well-known data driven technique used to extract patterns of common variation both from resting-state functional MRI (rs-fMRI) and arterial spin labeling MRI (ASL) data.[2] Our study aimed to: i) assess the consistency of ASL-derived cerebral blood flow (CBF) components (CBF-ICs) in healthy individuals (HI); ii) assess the similarity between the CBF-ICs and the spatial patterns of resting-state networks (RSN) and cerebral vascular territories (VT).[3]

Methods

ASL and rs-fMRI data were acquired for 92 HI (median age [range]=36.8 [13-80] years, 45 females) to derive CBF-ICs and RSN respectively. The images were pre-processed, then ICA was performed. Specifically, to test the CBF-ICs consistency, ICA (dimensionality=15) was run independently on two HI sub-groups (consisting of 46 HI each). To investigate the CBF-ICs similarity to RSN and VT atlas, ICA (dimensionality=20) was performed on the whole HI group data. The Dice Similarity index (DSI) was computed to quantify both the CBF-ICs consistency and the CBF- ICs similarity to RSN and VT (slight >0.1, moderate >0.2, substantial >0.4, almost perfect >0.6).

Results

Moderate to substantial consistency was found for CBF-ICs in the occipital and frontal lobes, thalamus and cerebellum. The similarity between CBF-ICs and RSN was moderate for fronto-parietal, salience and sensori-motor networks and substantial for visual ones. Default mode network (DMN) constitutive nodes were split into three different CBF-ICs. The overlap between CBF-ICs and VT was slight to moderate for the anterior and posterior cerebral arteries respectively, and substantial for the medial ones.

Conclusions

ICA performed on CBF maps allows to consistently identifying common spatial patterns in HI. Although ASL and rs-fMRI are both hemodinamically-driven techniques, CBF-ICs and RSN provide complementary information. Furthermore CBF-ICs showed a lateralization similar to VT atlas (*i.e.* split left/right hemispheres). Therefore, CBF-ICs mirror both the vascular anatomical segregation and the local functional demand.

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