Visualization of the lenticulostriate artery with flow-sensitive black-blood imaging in comparison with time-of-flight MR angiography

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Introduction: Lacunar infarct is considered to result from occlusion of lenticulostriate arteries (LSAs), therefore, it is important to observe these arteries. While Fushimi et al. [1] reported visualization of dilated LSAs in moya-moya patients with time-of-flight (TOF) MRA, it is more difficult to visualize LSAs in normal cases. Recently susceptibility weighted image (SWI) has been discussed as one of the ways of observing small vessels as black blood. In SWI, however, disturbance of phase is observed mainly in veins and it is not necessarily useful to visualize LSAs. On the other hand, signal from flowing blood can be attenuated applying very weak motion probing gradients to disturb refocusing moving spins only. This new acquisition method called Flow-Sensitive Black Blood (FSBB) [2]. FSBB is effective for both artery and vein, and its capability of visualization was compared with that of TOF.

Methods: Nineteen healthy subjects (11 males and 8 females, 19 - 44 years old) without any history of vascular disease were enrolled in this study after obtaining written informed consent. MRI examinations were performed by using FSBB and TOF methods in order to visualize LSAs originating from MCA (middle cerebral artery). A 1.5T MRI unit (EXCELART Vantage Powered by ATLAS, Toshiba Medical Systems, Tokyo) was used for acquisition. The scan parameters were TR=29ms, TE=6.8ms and FA=20 with MTC pulse for TOF and TR=29ms, TE=20ms and FA=20 with motion probing gradient of b=4sec/mm^2 and without MTC for FSBB. For both TOF and FSBB, one axial 3D slab of 160 slices was acquired and the resolution was 0.8mm^3. Images were reconstructed into coronal view and the number of visualized LSAs was counted, visualization quality was evaluated with a four-point scale (0 - 3), and the length of each LSA was measured separately for TOF and FSBB by two independent reviewers.

Results: The average numbers of branches visualized for a subject were 3.4 ± 1.1 and 1.5 ± 0.84 for FSBB and TOF, respectively on the right and 3.4 ± 0.96 and 1.7 ± 0.87, respectively on the left. There were significant differences between FSBB and TOF on both sides ($p<0.05$). Among 129 LSAs visualized by FSBB, 61 (47%) were also visualized by TOF. No LSA was visible only in TOF images. When the length of the branches observed by both methods was measured, average length was 23.5 ± 7.2mm and 18.3 ± 8.4mm for FSBB and TOF, respectively ($p<0.05$). As for the qualitative analysis, the average scores of visualization quality were 2.6 ± 0.49 and 1.5 ± 0.65 for FSBB and TOF, respectively ($p<0.05$).

Conclusion: We could better visualize LSAs with FSBB than with TOF, both quantitatively and qualitatively. FSBB is a promising method, however, it remains to be validated by conventional angiography and applied to pathological conditions such as lacunar infarct.

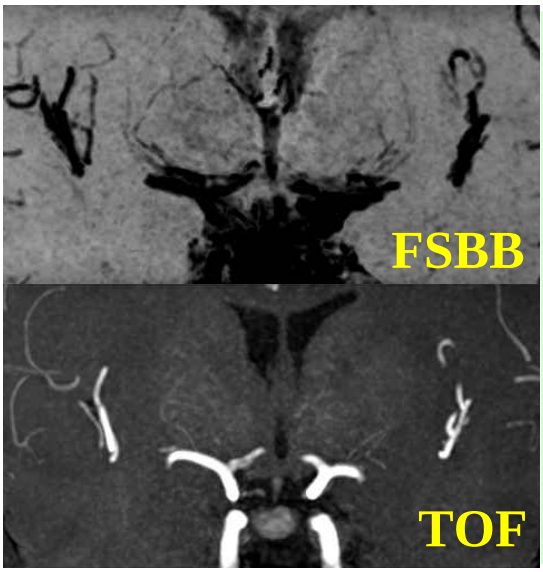

Fig.1 Visualized LSAs by FSBB and TOF

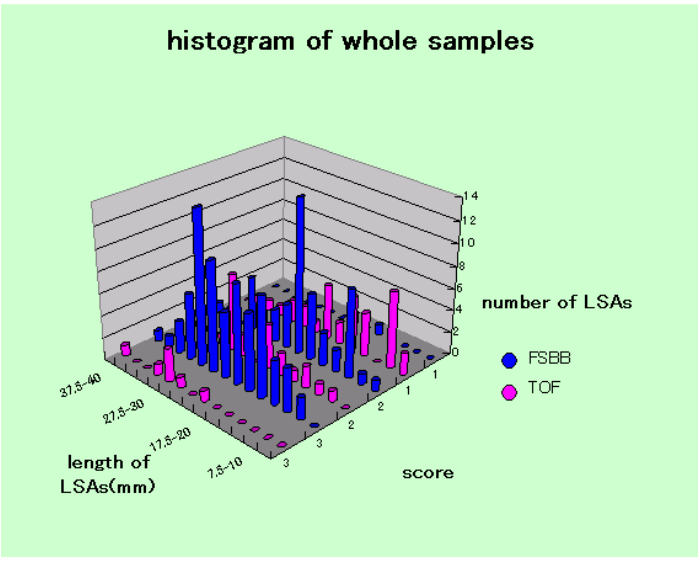

Fig.2 Histogram of whole sample data with 2 parameters

Bibliography: [1] Fushimi et al., Radiology 2006; 239:232. [2] Kimura T et al., Proc ISMRM 2007; 3015.