Evaluation of blood flow from STA-MCA Bypass by MRA with Off-Sagittal Saturation Pulse

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Purpose: The purpose of this study was to evaluate the feasibility of MRA with off-sagittal saturation pulse for discrimination between antegrade flow from internal carotid artery (ICA) and bypassed flow from superficial temporal artery (STA) following STA-MCA (middle cerebral artery) bypass surgery.

Materials and Methods: The subjects were 38 cases (27 male and 11 female, 7-84 year old of age, mean 57 years, 14 moyamoya disease and 24 ICA or MCA occlusive diseases) undergoing STA-MCA bypass surgery. MRA was performed on a 1.5 T clinical scanner. 3D-TOF technique was applied with following sequence parameters: TR: 35 ms, TE: 7.15 ms, flip angle: 25°, matrix: 320×224, slab: four 30 mm thick with an effective slice thickness of 0.6 mm.

Conventional MRA (cMRA) and MRA with off-sagittal saturation pulse covering STA and bypass point (sMRA) were obtained. sMRA demonstrates only antegrade flow because off-sagittal saturation pulse suppress signal of bypassed flow while cMRA shows both of antegrade and bypassed flow.

Subtracting source images of sMRA from those of cMRA gives source images and maximum-intensity-projection (MIP) images demonstrating bypassed flow with suppressed antegrade flow (Figure). These images were evaluated by the following criteria according to discrimination between antegrade and bypassed flow. When there was no misregistration, subtracted MIP image shows only bypassed flow. While, by increasing misregistration, contamination of antegrade flow prevented discrimination between bypassed and antegrade flow. We evaluated the degree of misregistration as follows. (A) Only bypassed flow shown on MIP image, (B) Some contamination of antegrade flow on MIP image, but still possible to discriminate bypassed flow, (C) Contamination was large and needs source images to discrimination, (D) Discrimination was impossible even on source images.

Results: Seven cases were assessed as (A), 14 as (B), 12 as (C), and 5 as (D). In 7 cases (18%) of 38 cases, subtracted MIP images demonstrated bypassed blood flow clearly without antegrade flow. Evaluating source images of cMRA and sMRA enabled to discriminate between antegrade and bypassed flow and evaluate them separately in 33 cases (87%) of 38 cases.

Conclusion: STA-MCA bypass is a method of direct revascularization for moyamoya disease, ICA or MCA stenosis/occlusion. Obtaining sMRA as well as cMRA can distinguish bypass blood flow from antegrade flow and evaluate them separately. sMRA is feasible technique for the post-operative assessment of STA-MCA bypass function.

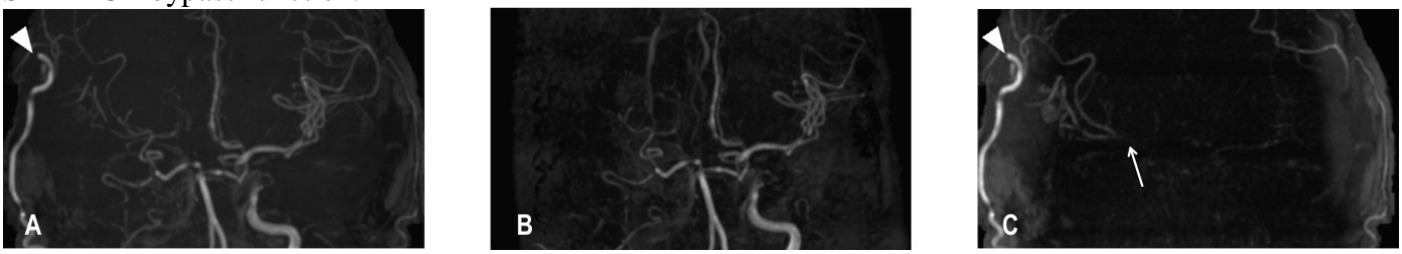

Figure. 60-year-old male with right ICA occlusion, MIP images (anterior-posterior projection) of conventional MRA (A), MRA with off-sagittal saturation pulse (B), and subtracted MRA (C)
Subtracting (B) from (A) gives (C) which demonstrates bypassed flow clearly and its extent to M1 segment of MCA (arrow). Arrowhead shows bypass point.