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A proposed method for outlining occluded intracranial artery using 3D T2-weighted sampling perfection with application optimized contrasts using different flip angle evolution (SPACE)

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Abstract

High-resolution vessel wall imaging techniques have been developed for clinical use in various types of intracranial artery disease. Numerous studies have described techniques for evaluating remodeling patterns and plaque character, but few have reported a method for outlining obstructed vessels in intracranial artery occlusion. The course of the vessel affects the success of recanalization and can cause complications in mechanical thrombectomy for acute ischemic stroke. We propose imaging with 3D T2-weighted sampling perfection with application optimized contrasts using different flip angle evolution (SPACE) as a useful tool for describing the course of an occluded artery in ischemic stroke due to intracranial artery occlusion.

Keywords

MR-imaging, ischemia/infarction, arteries

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Introduction

Mechanical thrombectomy (MT) is being used increasingly worldwide for treatment of acute intracranial artery occlusion and numerous studies have confirmed its effectiveness. However, because the course of the occluded vessel cannot be visualized prior to MT, the surgeon must perform MT 'blind'. Here, we report a case of acute ischemic stroke due to middle cerebral artery (MCA) occlusion in which the course of the occluded MCA was successfully visualized using 3D T2-weighted imaging, obtained using the sampling perfection with application optimized contrasts using different flip angle evolution (SPACE) sequence.

Case history

An 82-year-old man admitted to our hospital with pneumonia suffered sudden right hemiparesis prior to discharge. Magnetic resonance imaging revealed acute ischemic stroke due to left MCA occlusion. Although the occlusion was detected within 5 h after onset, we did not perform MT because the diffusion weighted imaging -Alberta stroke program early computed tomography scores was only 2 and there was no mismatch. After deciding the treatment policy, we performed T2-SPACE to obtain information regarding the occluded artery.

The T2-SPACE imaging parameters were: TR, 2400 ms; TE, 244 ms; FOV, 200 mm; matrix, 256×256; slice thickness, 0.8 mm; flip angle mode, T2 variable (standard); blood suppression, free (100 mTms); scan time, 2 min 30 s. A radiologist then

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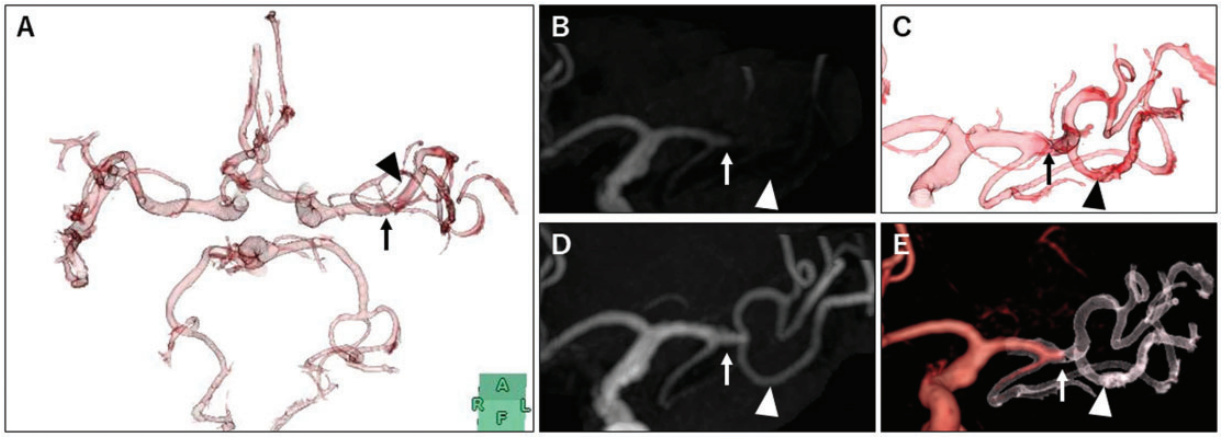

Fig. 1 3D T2-weighted sampling perfection with application optimized contrasts using different flip angle evolution (SPACE) can depict the intracranial main artery clearly (a). 3D time-of-flight magnetic resonance angiography (TOF-MRA) at admission shows occlusion of the left middle cerebral artery (MCA) at the M1 segment (b). The distal course of the occluded left MCA is clearly visible on 3D T2-SPACE (c). The course of the vessel is consistent with that on TOF-MRA before stroke onset (d). The fusion image (e) created with 3D TOF-MRA (b) and 3D T2-SPACE (c) clearly reveals the occluded left MCA. The arrows and arrowheads indicate the same position of the left MCA in each subfigure.

constructed the 3D image using SYNAPSE VINCENT Ver. 4.6 (FUJIFILM, Tokyo, Japan). The 3D T2-SPACE image of the intracranial arteries (Fig. 1(a)) could depict vessels clearly. The distal course of the occluded left MCA was not seen on 3D time-of-flight magnetic resonance angiography (TOF-MRA) (Fig. 1 (b)) but was clearly visible on 3D T2-SPACE (Fig. 1 (c)), consistent with that seen on TOF-MRA prior to onset of stroke (Fig. 1(d)). A fusion image of the T2-SPACE and TOF-MRA images (Fig. 1(e)) focusing on the obstructed area could be obtained within 5 min.

Discussion

3D-SPACE sequence employs a variable flip angle, a high turbo factor, and a longer echo train with sufficient signal levels that favors fast imaging to achieve good vascular flow void.[1,2] This sequence has been reported that enables high spatial resolution, superior contrast to noise ratio, and time efficiency than conventional 2D T2-weighted sequence.[2] Because this sequence is intended mainly for evaluation of wall features, suppression of cerebrospinal fluid (CSF) is important.[3–5] Here, we employed T2-weighted images, in which the contrast between the low-intensity flow void of the vessels and the high-intensity CSF permits vessel identification without contrast medium. To our best knowledge, this is the first report to demonstrate the feasibility of T2-SPACE for imaging of occluded vessels.

In MT, hemorrhagic risk is higher in M2 occlusion than M1 occlusion,[6] and hemorrhagic risk and the recanalization ratio are related to the course of the distal MCA.[7,8] Therefore, it is very important to determine the course of occluded vessels before MT for reducing complications and will enable good recanalization. The fusion image using T2-SPACE presented here is simple to create and requires an imaging time of ~2.5 min and a reconstruction time of ~5 min. We consider that the technique has potential as a preoperative examination in acute ischemic stroke that requires MT. Convenience is extremely important; therefore, fusion imaging is suitable for preoperative examination in acute ischemic stroke, particularly in facilities that allow MR images to be acquired prior to other diagnostic imaging examinations.

Prediction of the course of the MCA by imaging retrograde flow using cone beam computed tomography and by using 3D fast imaging employing steady-state acquisition have been reported,[9,10] but it is unclear which method is most appropriate to obtain information regarding the course of the occluded vessel that would be sufficient to support MT. We have included only one case in this report; however, we plan to acquire fusion images in more patients and perform more detailed studies in the future.

In conclusion, T2-SPACE imaging appears to be a simple and effective method for determining the course of the occluded vessel and may be useful for MT in acute ischemic stroke.

Authors' note

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Contributorship

Saya Ozaki: Writing-Original Draft, Writing-Review & Editing
Shigetaka Okamoto: Methodology
Naoki Shinohara: Supervision
All authors pledge that this manuscript does not contain previously published material and is not under consideration for publication elsewhere.

Consent for publication

Informed consent for the publication of his medical information and images was obtained under the approval of the local ethics committee at HITO Hospital, Japan. The patient gave his written informed consent for the publication of his medical information and images.

Declaration of Conflicting Interests

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