Clinical Significance of Ischemic Hypointense Findings in Vessels and Tissue in Gradient Echo T2*-Weighted Images at 3 Tesla Evaluated by Simple Visual Estimation in Stroke Patients Treated with Intravenous rt-PA

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Introduction: The visual estimation of the ischemic vessel (IschV) and ischemic tissue (IschT) signs[1)2)] were compared with the clinical outcome after intravenous recombinant tissue plasminogen activator (rt-PA). The purpose of this study was to determine the clinical significance of IschV and IschT signs in gradient echo T2*-weighted images (Gre T2*-WIs) and the correlation of clinical outcome with visual recognition of these signs.

Methods: From 43 patients who were suspected of having acute anterior-circulation ischemia and who received intravenous rt-PA within 3 hours of stroke-onset, 33 patients with occlusion of an internal carotid artery or middle cerebral artery were included in this study. They underwent MR imaging both at baseline and again 22–24 hours after rt-PA injection. The MRI protocol for acute stroke in our institution routinely includes DWIs, Gre T2*-Wis and MRA of the intracranial vessels. Two observers assigned three grades to the ischemic signs; where grade 0 = no asymmetry, 1 = mild asymmetry, and 2 = remarkable asymmetry and Kappa analysis was conducted to evaluate the level of consistency. A perfusion study by flow-sensitive alternating inversion recovery (FAIR) imaging without a contrast medium infusion could be conducted in 18 of the 33 subjects. For quantitative comparison between the hypointense finding on Gre T2*-WIs and FAIR imaging in the ischemic tissue, the asymmetry ratios were calculated by placing three small regions of interest in the ischemic parenchyma and the contralateral tissues excluding hyperintense finding in the large vessels. All MRI studies were performed using a clinical 3-tesla MRI instrument (Signa 3T HD; GE, Milwaukee, WI, USA) with a standard quadrature head coil. For quantitative comparison between the hypointense finding on Gre T2*-WIs and FAIR imaging in the ischemic tissue, the asymmetry ratios were calculated by placing three small regions of interest in the ischemic parenchyma and the contralateral tissues excluding hyperintense finding in the large vessels. The intracranial hemorrhages (ICH) after rt-PA therapy were classified according to the following European Cooperative Acute Stroke Study (ECASS) definitions: hemorrhagic infarction (HI) and parenchymal hemorrhage (PH). The clinical outcome following intravenous rt-PA thrombolysis was evaluated by >= 4 points changes in NIHSS score between baseline and 30 days after thrombolysis.

Results: The typical IschV and IschT sign are shown in Fig 1. The good observer agreement was confirmed based on the kappa values (κ = 0.83 for the IschV sign and κ = 0.81 for the IschT sign).The rates of IschV and IschT positive sign were 79% and 62%, respectively. There was no significant difference between positive and negative IschV sign in the number of patients with deteriorated outcome. However, there was a statistically significant difference (p=0.03) between positive and negative IschT sign for those with deteriorated outcome, which showed higher statistical significance than the volume of initial DWI lesion (p=0.09). The correlation between hemorrhage type and the ischemic signs is summarized in Fig. 2. All three cases in the PH group showed both the number of cases with the IschV and IschT signs, however, the frequency of the IschV and IschT signs was not remarkably different between the no ICH group and the HI group. The correlation of asymmetry ratio in the ischemic area between T2*-WIs and FAIR images is demonstrated in Fig. 2, and shows moderate correlation with statistical significance (ρ = 0.51, p = 0.03). The slope of the approximately linear line between FAIR images and T2*-WI is 1.21, indicating that the difference of asymmetry ratio in FAIR images was larger than that in T2*-WI.

Conclusions: The current study may indicate that IschT sign in Gre T2*-WI at 3 tesla would include more severe ischemia than IschV sign and is therefore a candidate for determination of risk for deteriorated outcome with Gre T2*-WI at 3 tesla. However, there was no significant different frequency of positive ischemic signs between no ICH group and HI type hemorrhage on ischemic signs.
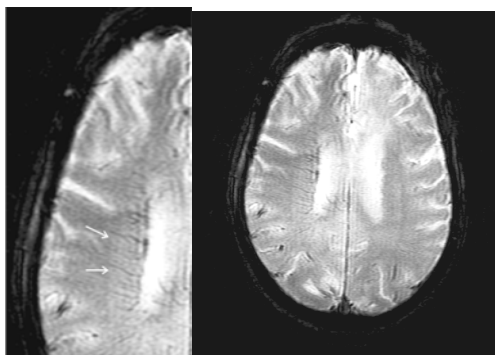

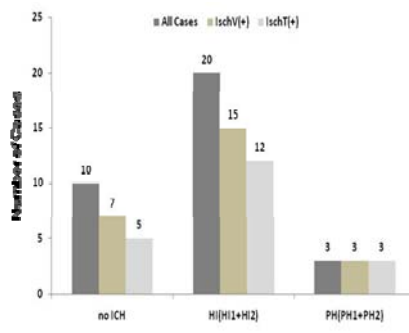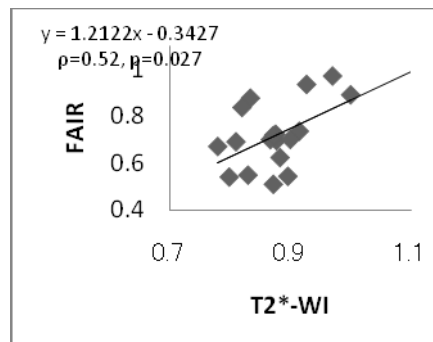Fig.1 Examples of the ischemic vessel sign and tissue sign.   Fig.2 Classification of ICH type and ischemic signs   Fig.3 The correlation using the asymmetry ratios

References 1)Morita et al. Ischemic findings of T2*-weighted 3-Tesla MRI in acute stroke patients. Cerebtovasc Dis. 2008;26:367-375.

2) Hermier M et al. Hypointense leptomeningeal vessels at T2*-weighted MRI in acute ischemic stroke. Neurology. 2005;65:652-653.