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CLINICAL IMAGE

Detection of Cerebral Venous Sinus Thrombosis on a R2* Map

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Cerebral venous sinus thrombosis (CVST) is a critical cerebrovascular disease with no standard imaging protocol currently established. Digital subtraction angiography and contrast-enhanced CT or MR venography (MRV) has been considered the gold standard for diagnosing CVST, whereas they have a risk of thromboembolic events or side effects of contrast media. Recently, non-contrast MRV has been used for diagnosing CVST due to its non-invasiveness. Loss of flow voids on T_1- and T_2-weighted imaging would be useful findings for indicating CVST, but the sensitivities may not always be sufficient. Although T_2^*-weighted imaging (T_2^*WI) demonstrates susceptibility blooming effect corresponding to the thrombus, it is difficult to distinguish from other paramagnetic substances such as venous congestion or hemorrhage, and strong susceptibility artifacts from the skull base deteriorate image quality in the posterior fossa. Iterative decomposition of water and fat with echo asymmetry and least-squares estimation (IDEAL) IQ (GE Healthcare, Milwaukee, WI, USA) is a commercial software equipped with 3D gradient multi-echo chemical-shift based water-fat separation and simultaneous R2* estimation techniques.[1] A quantitative iron image termed R2* map as well as in- and out-of-phase images, water and fat images, and fat fraction map can be obtained by a single scanning with short acquisition time.[1–3]

We present a patient of 2-month-old boy with severe diarrhea and tonic convulsion. MR examination was performed on a Discovery MR750w 3.0T (GE Healthcare, Milwaukee, WI, USA) using a 32-channel head coil. The sedation was performed during MRI by slow intravenous injection of thiopental sodium (Ravonal; Tanabe-Mitsubishi, Osaka, Japan). T_2^*WI showed a prominent susceptibility effect in the right transverse sinus, left transverse-sigmoid sinus, left vein of Labbé, left basal vein of Rosenthal, straight sinus, vein of Galen, and bilateral internal cerebral, thalamostriate, and atrial veins. R2* map by IDEAL IQ also showed a strong susceptibility effect in those vessels, which was distinguishable from the signal intensity of normal veins or parenchyma clearer than that on T_2^*WI. MRV demonstrated signal loss in the left transverse-sigmoid sinus, straight sinus, vein of Galen, and bilateral internal cerebral, thalamostriate, and atrial veins. (Figs. 1 and 2). Clinical symptoms showed improvement after receiving rehydration and anticoagulant therapies, and follow-up MRI showed reduction of susceptibility effect on R2* map with increased signal intensity at the occluded vessels on MRV. The parameter of IDEAL IQ was as follows: TR, 8.3 ms; TE, six different echoes ranging from 1.2 to 7.2 ms; FOV, 21 cm; matrix, 256 × 256; slice thickness, 2.0 mm; 60 slices; acquisition time, 1 min 47 s.

We have reported that the R2* map enables the generation of quantitative susceptibility-sensitive image that can detect intra-arterial acute thrombus with high accuracy.[2,3] To our knowledge, this is the first report to present on the utility of R2* map in CVST. The short multi-echo acquisition for R2* map enables slight differences in T_2^* decay caused by susceptibility effect to be distinguished, and allows them to be visualized with reliable image contrast. R2* map may have a great potential as a complimentary MRI protocol for acute CVST.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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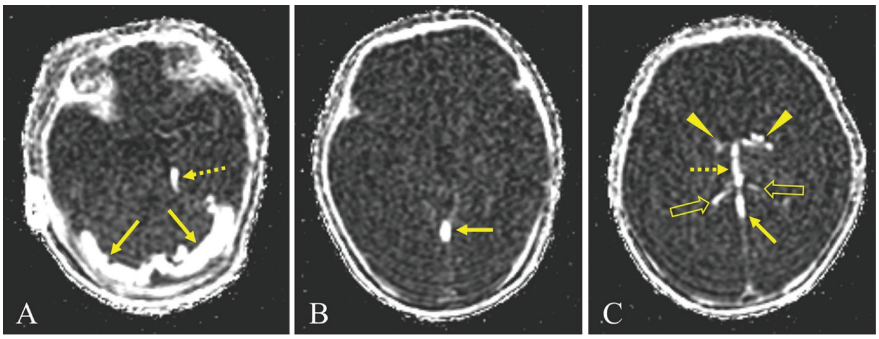

Fig. 1 Imaging findings of R2* map generated by IDEAL IQ. R2* map shows prominent susceptibility effect in the right transverse sinus, left transverse-sigmoid sinus (**A**: arrows), left vein of Labbé, left basal vein of Rosenthal (**A**: dotted arrow), straight sinus (**B**: arrow), vein of Galen (**C**: arrow), bilateral internal cerebral veins (**C**: dotted arrow), bilateral thalamostriate veins (**C**: arrowheads), and bilateral atrial veins (**C**: blanked arrows).

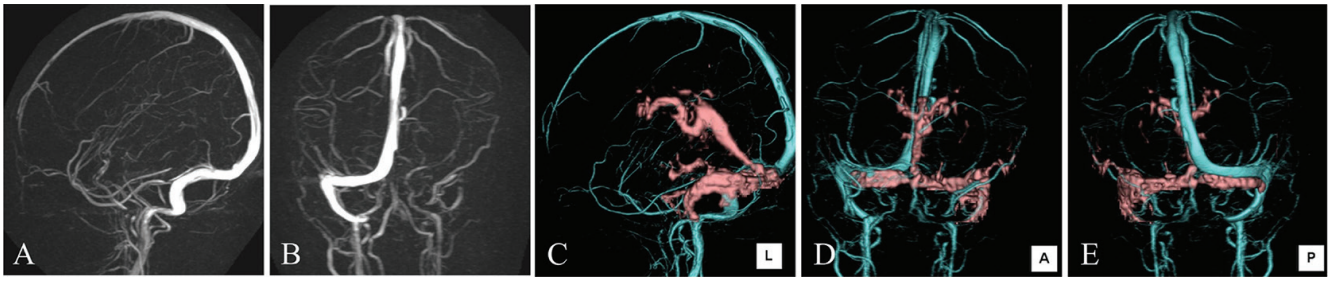

Fig. 2 Maximal intensity projection of MR venography (MRV) (**A** and **B**) and volume rendering fusion image of R2* map and MRV (**C**-**E**). MRV demonstrates signal loss in the left transverse-sigmoid sinus, straight sinus, vein of Galen, bilateral internal cerebral veins and bilateral thalamostriate veins (**A** and **B**). Fusion image of R2* map and MRV can show the localization between acute venous thrombus (red) and unaffected sinuses or veins (light blue) clearly. Note that acute thrombus in the right transverse sinus on R2* map occupies only inferomedial part of the sinus, so that signal intensity from right transverse to sigmoid sinus can be seen on MRV.

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