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Case Report

Susac's syndrome: Leptomeningeal enhancement on 3D FLAIR MRI

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Abstract

Background: Contrast-enhanced (ce) fluid-attenuated inversion recovery magnetic resonance imaging (FLAIR MRI) has recently been shown to identify leptomeningeal pathology in multiple sclerosis.
Objective: To demonstrate leptomeningeal enhancement on three-dimensional (3D) FLAIR in a case of Susac's syndrome.
Methods: Leptomeningeal enhancement was correlated with clinical activity over 20 months and compared to retinal fluorescein angiography.
Results: The size, number, and location of leptomeningeal enhancement varied over time and generally correlated with symptom severity. The appearance was remarkably similar to that of retinal vasculopathy.
Conclusion: Ce 3D FLAIR may aid in diagnosis and understanding of pathophysiology in Susac's syndrome and may serve as a biomarker for disease activity.

Keywords: Susac's syndrome, contrast-enhanced FLAIR, leptomeningeal pathology

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Introduction

Susac's syndrome is an unusual vasculopathy that can be misdiagnosed as multiple sclerosis (MS). Histopathology has shown retinal and leptomeningeal endothelial inflammation.[1,2] Recent work has shown the utility of contrast-enhanced (ce) three-dimensional fluid-attenuated inversion recovery (3D FLAIR) in identifying leptomeningeal enhancement in MS.[3] We present a case where ce 3D FLAIR demonstrated leptomeningeal enhancement superior to ce T1W sequences, and in a pattern and course distinct from that described for MS.

Case report

A 39-year-old male presented with intermittent visual disturbance, facial numbness, dysarthria, headache, fatigue, and memory impairment. Brain magnetic resonance imaging (MRI) revealed microinfarctions in the splenium of the corpus callosum, as well as in the right temporal and frontal lobes. Transesophageal echo and laboratory screening for vasculitis were negative. Cerebrospinal fluid (CSF) showed mild pleocytosis and protein elevation. Retinal fluorescein angiography (RFA) demonstrated arteriolar wall hyperfluorescence (AWH) (Figure 1(a)). Audiometry showed transient hypoacusis. Repeat MRI showed progressive number of small foci of restricted diffusion in the corpus callosum and the supratentorial gray and white matter, as well as FLAIR hyperintensities/T1 hypointensities in the corpus callosum. Punctuate and small patchy contrast enhancements were seen in the white matter and leptomeninges on two-dimensional (2D) and 3D T1W images. Ce FLAIR was not performed at that stage. Susac's syndrome was diagnosed based upon clinical presentation, MRI and RFA findings, and was initially treated with corticosteroids, intravenous immunoglobulin (IVIG), and antiplatelet therapy.

Symptoms waxed and waned over the following 20 months. RFA AWH varied in number and location. Ten MRI exams including ce 3D FLAIR sequence were performed over this time, with leptomeningeal foci of enhancement seen on ce 3D FLAIR revealing substantial variability in extent and location. At 6 months after disease onset, at a time of severe clinical worsening, ce 3D FLAIR MRI showed innumerable thick linear or branching hyperintensities up to 10 mm in length, with no corresponding enhancement visible on ce 3D T1 (Figure 1(b) and (c)).

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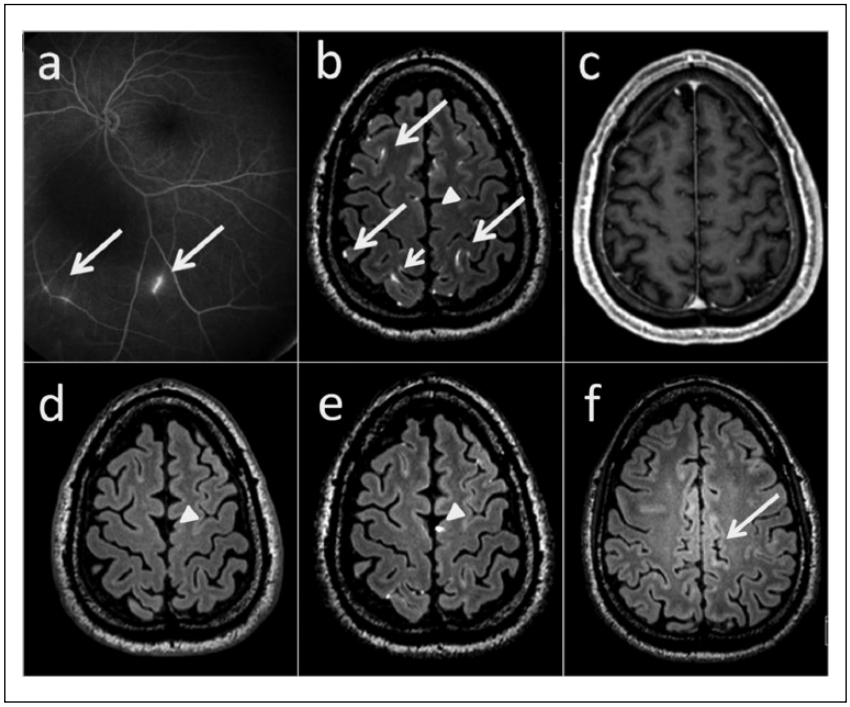

Figure 1. Retinal fluorescein angiography (RFA) and MRI findings in a 39-year-old male diagnosed with Susac's syndrome. (a) RFA shows arteriolar wall hyperfluorescence (arrows). (b)–(f) axial 1-mm reconstruction of sagittal 3D images: (b) gadolinium-enhanced 3D FLAIR image obtained at 6 months follow-up at a time of severe clinical worsening reveals multiple linear hyperintensities at the convexity surface (arrows) believed to represent leptomeningeal vasculopathy. While the pattern of enhancement is mainly linear, y-shaped enhancements were identified, suggesting vascular branching (short arrow). (c) Gadolinium-enhanced 3D T1W image (acquired immediately after the enhanced 3D FLAIR image shown in (b)) fails to reveal corresponding leptomeningeal enhancement. (d) Pre- and (e) post-contrast 3D FLAIR images obtained 2 months later, at the time of clinical improvement, show substantial decrease in the number of leptomeningeal enhancements, with enhancements showing different sizes and locations compared to the earlier scan (b) and not visible before contrast application (d). The arrowheads mark identical locations in (b), in (d), and in (e). (f) Gadolinium-enhanced 3D FLAIR image obtained 21 months after disease onset, when the patient was asymptomatic, shows only scarce residual tiny dots of leptomeningeal enhancement (arrow).

At 8 months, after further high-dose steroids and clinical improvement, 3D ce FLAIR showed few dot-like or short linear enhancements, not visible on pre-contrast 3D FLAIR (Figure 1(d) and (e)), and substantially different in size and location compared to that seen at 6 months. Another MRI exam 21 months after disease onset, when the patient was nearly asymptomatic, showed very scarce tiny dots of leptomeningeal enhancement on ce 3D FLAIR (Figure 1(f)) At each exam, the ce 3D FLAIR acquisition preceded the ce T1W sequence. The parameters for 3D FLAIR were essentially identical for 1.5T and 3T field strength (details are provided in the Supplementary Material, available online).

Discussion

The 3D FLAIR MRI has shown high sensitivity for detection of enhancement in CSF, superior to ce 2D T1W and 3D magnetization-prepared rapid acquisition with gradient echo (MPRAGE) imaging in the assessment of certain leptomeningeal pathologies.[4,5] Additional insensitivity to flowing blood in cortical veins, suppression of CSF pulsation artifact, and high spatial resolution add to utility of 3D FLAIR in identifying leptomeningeal enhancement.[4]

Using ce 3D FLAIR at 3T, Absinta et al.[3] identified mainly nodular or small linear-shaped leptomeningeal enhancing foci in MS patients, corresponding to perivascular inflammation and meningeal lymphoid follicles, known to occur in MS. Of note, these foci were mainly stable in shape and location over mean follow-up of 1.4 years. A qualitatively and temporally different pattern of leptomeningeal enhancement is seen in this case of Susac's syndrome, being highly variable over time. We believe that these foci of enhancement in Susac's syndrome likely represent contained areas of vascular leakage secondary to endotheliopathy.

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Pathologic evaluation in Susac's syndrome has shown perivascular lymphocytic infiltration around small- to medium-sized leptomeningeal vessels.[2] Retinal pathology reveals peripheral vascular endothelial cell necrosis and open junctions resulting in breakdown of blood–retinal barrier.[1] Association of Susac's syndrome with anti-endothelial cell antibodies further supports the role of endothelial pathology.[6] The striking similarity in appearance and variability of the RFA AWH findings, known to be caused by vascular leakage,[1,7] and the ce 3D FLAIR findings at the leptomeninges, suggests similar mechanism of retinal and leptomeningeal endothelial pathology in Susac's syndrome.

Longitudinal follow-up in this patient over 20 months shows general correlation of severity of symptoms with the extent of leptomeningeal enhancement on ce 3D FLAIR, but accurate correlation is limited due to the subjective nature of some of the symptoms. At times the extent of enhancement when imaged at 1.5T far exceeded enhancement done at a preceding time point at 3T, so that field strength did not appear to be a cause for varying appearance over time. Also, the extent of leptomeningeal enhancement, when present, consistently exceeded enhancement seen on T1W sequences. Some reports have described leptomeningeal enhancement on ce 3D T1W images in up to 33% of cases of Susac's syndrome but have suspected this to be underestimated.[8] The ability of ce 3D FLAIR to detect leptomeningeal enhancement when not visible on 3D T1W suggests an improved method for assessing leptomeningeal pathology in Susac's syndrome.

Summary

Ce 3D FLAIR may be useful in identifying unique leptomeningeal vasculopathy in Susac's syndrome and potentially may facilitate prompt diagnosis and treatment. In particular, the varying enhancement pattern of vascular leakage may be helpful in differentiating from the mostly stable enhancement pattern seen in MS. Future studies are needed to determine whether the temporal and spatial appearances of leptomeningeal enhancement is useful in distinguishing Susac's syndrome from other etiologies, and whether it can be applied to monitor disease activity.

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Conflict of interest

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