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Technical Note

Diagnosis of demyelinating brain lesion simulating brain tumors on fast imaging employing steady-state acquisition magnetic resonance imaging

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Abstract

Background: A single inflammatory demyelinating brain lesion sometimes mimics a brain tumor on conventional magnetic resonance imaging (MRI), and thus poses a considerable diagnostic challenge. We assessed the usefulness of a new MRI technique, fast imaging employing steady-state acquisition (FIESTA), for the diagnosis of inflammatory demyelinating disease (IDD).

Methods: Three patients (2 males, 1 female) with a histopathologically proven inflammatory demyelinating brain lesion which mimicked a brain tumor on MRI were evaluated with a post-contrast three-dimensional FIESTA sequence before biopsy and treatment. Those images were compared with the images of intra-axial brain tumors (n = 147).

Results: Preoperative FIESTA showed an iso- or slightly hyperintense distinct intralesional structure that appeared reticulate or broad-line in patients with IDD. These structures traversed a hyperintense demyelinating lesion in the deep grey matter (DGM) and were connected to the surrounding extralesional area, which appeared to be dense fibers between DGM. Such distinct intralesional structures were not observed in most brain tumors.

Conclusion: Reticulate or broad-line-like intralesional structures on FIESTA may, therefore, be suggestive of IDD rather than indicate a brain tumor.

Key Words: Brain tumor, deep gray matter, FIESTA, inflammatory demyelinating lesion

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INTRODUCTION

Acute large or single demyelinating brain lesion distant from the lateral ventricles mimics a neoplasm such as glioma or lymphoma on conventional magnetic resonance imaging (MRI), hence the frequent need for biopsy to confirm the diagnosis.[2] A new MRI technique, fast imaging employing steady-state acquisition (FIESTA) MRI, is suitable for depicting the cranial nerves in the cisterns because the sequence

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has a high spatial resolution and signal-to-noise ratio.[1,8] FIESTA is also useful for the demonstration and identification of parenchymal solitary cysticercus granuloma, suggesting that FIESTA can demonstrate small structures or lesions in not only the cisterns but also the brain.[4]

In the present study, we report the characteristic findings of inflammatory demyelinating disease (IDD) on FIESTA, which might be helpful for distinguishing IDD from brain tumors.

MATERIALS AND METHODS

This retrospective study was approved by the Institutional Review Boards of Shiga University of Medical Science and performed in accordance with the ethical standards laid down in the 1975 Declaration of Helsinki and its later amendments.

The inclusion criteria for this study were: (1) preoperative MRI showing intra-axial tumor-like lesion; (2) pathological evidence of demyelinating lesion or brain tumors; and (3) preoperative post-contrast FIESTA available for review. From January 2009 to December 2015, 3 patients (2 males, 1 female) with IDD and 147 patients with brain tumors were retrospectively evaluated at a single institution.

Imaging was performed using a 3.0-T or 1.5-T MRI system. The three-dimensional (3D) FIESTA sequence used in 3.0-T MRI was as follows: TR, 3.872–4.008; TE, 2.1; flip angle, 45°; field of view, 240 × 240 mm; matrix, 512 × 512; and section thickness, 0.9 mm. The 3-D-FIESTA sequence used in 1.5-T MRI was as follows: TR: 6.656; TE, 3.2; flip angle, 45°; field of view, 240 × 240 mm; matrix, 512 × 512; section thickness, 1.4 mm.

RESULTS

Preoperative FIESTA showed intralesional mildly hyperintense or isointense reticulate [Figure 1a and b, arrows and arrowheads], branching broad-line [Figure 1c and d, arrowheads], or broad-line [Figure 1e and f, arrow and arrowhead] structures that traversed the hyperintense lesions and were connected to the surrounding extralesional area in the three patients with IDD in the deep grey matter (DGM). In all but one brain tumor, preoperative FIESTA showed a homogeneous (n = 25) or heterogeneous (n = 105) appearance but no distinct intralesional reticulate or broad-line structures [Table 1]. These results suggest that either reticulate or broad-line-like intralesional structures on FIESTA may suggest the occurrence of IDD rather than indicate the presence of a brain tumor.

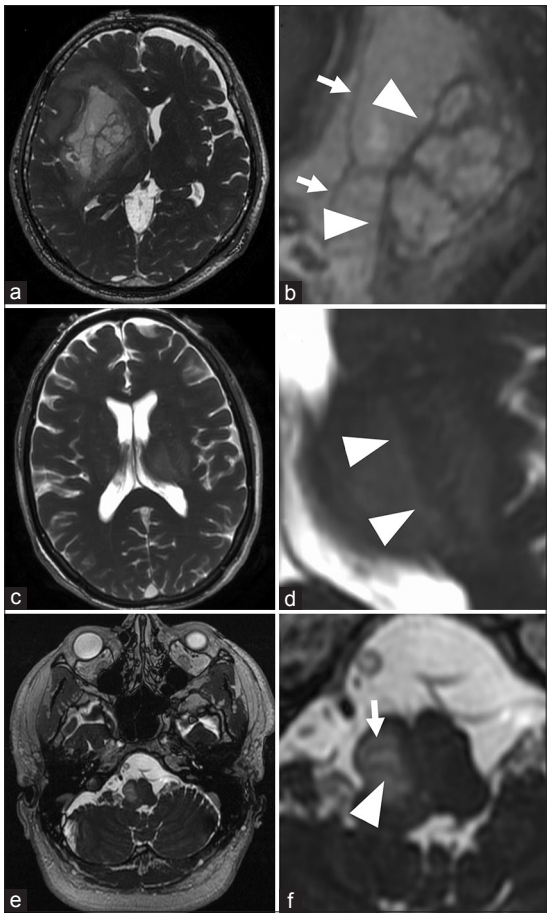

Figure 1: IDD lesions on FIESTA. FIESTA images (a, c and e) and their enlarged view (4×) (b d and f) in three cases with IDD. Arrows and arrowheads show an intralesional reticular or broad-line appearance

DISCUSSION

Our data suggest that FIESTA may be useful for differentiating between IDD and brain tumors when the images show reticulate or broad-line structures in the lesions.

FIESTA provides a high signal in tissues with high T2/T1 ratios, such as cerebrospinal fluid and fat, enables submillimeter spatial resolution, and has been mainly used to evaluate the cerebellopontine angles and inner ear, allowing the precise differentiation between branches of the cranial nerves.[8] Recently, this sequence has been reported to be useful in the demonstration of not only intraventricular lesions but also parenchymal lesions.[4,5] In the present study, FIESTA showed intralesional reticulate or broad-line structures in inflammatory demyelinating lesions in the DGM. The structures may anatomically correspond to the lateral medullary lamina of the corpus striatum [arrow heads in Figure 1b], the external capsule [small arrows in Figure 1b], the internal capsule between the dorsal thalamus and putamen [Figure 1d], the olivocerebellar fibers [small arrow in Figure 1f], and

Table 1: Intralesional appearance of brain tumors on FIESTA

	Reticular	Homo	Hetero	Multiple microcyst
Pilocytic astrocytoma		2	4	1
Diffuse astrocytoma		9	6	1
Anaplastic astrocytoma		5	4	
Glioblastoma			30	6
Oligodendroglioma				1
Oligoastrocytoma		2	2	1
Anaplastic oligoastrocytoma			1	1
Anaplastic ependymoma			4	
Astroblastoma			1	
Subependymoma				2
SEGA			1	
Pleomorphic xanthoastrocytoma			2	
Ganglioglioma			1	
Medulloblastoma			3	
PNET			4	
Germinoma	1	3	5	3
Teratoma			2	
Hemangioblastoma		2	2	
Malignant lymphoma			9	
Metastatic tumor		2	24	

FIESTA: Fast imaging employing steady state acquisition; Reticular: Reticular, broad-line or cord-like; Homo: Homogeneous; Hetero: Heterogeneous; IDD: Inflammatory demyelinating disease; SEGA: Subependymal giant cell astrocytoma; PNET: Primitive neuroectodermal tumor

the amiculum of olive [arrowhead in Figure 1f], which are dense fibers between the DGM nuclei and/or between sparse-fiber areas. Because FIESTA can demonstrate structures with high water content in the brain parenchyma, we speculate that FIESTA may be able to reveal dense fibers between edematous, high-water-containing DGM.[4] Although acute inflammation occurs in both the white and gray matter, structural differences might result in differences in the water content between dense fibers and DGM in the lesions.[3] However, FIESTA showed a homogenous or heterogeneous appearance in most brain tumors. Brain tumors can distort, diffusely invade, and/or destroy fibers and the nuclei with disorderly proliferating tumor cells, which may result in blurred structural difference and diffuse water distribution in the lesion.[6,7] FIESTA might be a useful noninvasive sequence for distinguishing IDD from brain tumors.

To our knowledge, the present report is the first to describe the features of IDD on FIESTA and explore its potential usefulness for diagnosing IDD. Because no definite diagnostic imaging modality has been developed for a single inflammatory demyelinating brain lesion mimicking a brain tumor, the intralesional findings on FIESTA might be helpful for diagnosing IDD in combination with other findings on postcontrast T1-weighted images, diffusion-weighted images, MRS, and other modalities.

CONCLUSION

Although the present study was a retrospective review of a small population, FIESTA may be a useful noninvasive modality for distinguishing IDD from brain tumors in the DGM.

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Conflicts of interest
The authors declare no conflicts of interest in association with this study.

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