

MORE SENSITIVE MRI TECHNIQUES FOR DETECTING FOCAL CORTICAL DYSPLASIA

Focal Cortical Dysplasia: Improving Diagnosis and Localization with Magnetic Resonance Imaging Multiplanar and Curvilinear Reconstruction

Montenegro MA, Li LM, Guerreiro MM, Guerreiro CA, Cendes F

J Neuroimaging 2002;12(3):224–230

OBJECTIVE: To establish the contribution of multiplanar reconstruction (MPR) and curvilinear reformatting (CR) to the MRI investigation of focal cortical dysplasia (FCD).

METHODS: From a group of patients with intractable frontal lobe epilepsy, we selected patients with neuroimaging diagnosis of FCD. The diagnosis of FCD was based on the neuroimaging findings after a three step evaluation, always in the same order: (a) plain MRI films, (b) MPR, and (c) CR. After the selection of patients, the process of reviewing all the images in the three stages described was performed by one of us, who did not take part on the selection of patients or on the initial evaluation, and who was blind to the clinical and EEG findings of the patients. For data analysis, we first assessed the contribution of the additional findings of MPR analysis compared with the results of the evaluation using only plain MRI films, as is usually done in routine practice. Second, we assessed the contribution of CR to the findings of plain MRI films plus MPR. After completing the multistep evaluation, we all went back to review the plain MRI films with knowledge of lesion topography, to identify possible subtle features associated with FCD.

RESULTS: Seventeen patients met the inclusion criteria. Twelve had imaging diagnosis of FCD and were included in the second step of this project. Plain films of high-resolution MRI showed the lesion in six (50%) of the 12 patients. By adding MPR to the plain MRI films, we identified lesions in all 12 patients. Furthermore, we found that MPR provided a better lesion local-

ization and ascertainment of its relation to other cerebral structures in five (83%) of six patients who had a lesion identified on plain films. By adding CR to the plain MRI films plus MPR analysis, we observed that (a) CR also allowed the identification of the dysplastic lesion in all patients, (b) CR improved lesion localization in one patient, and (c) CR provided a better visualization of the lesion extent in four patients (33%), showed a larger lesion in three, and demonstrated that part of the area suspected as abnormal was more likely volume averaging in two.

CONCLUSIONS: MPR and CR analysis add to the neuroimaging evaluation of FCD by improving the lesion diagnosis and localization. CR helps to establish the extent of the lesion more precisely, allowing the visualization of some areas not shown on high-resolution MRI and MPR. These techniques are complementary and do not replace the conventional wisdom of MRI analysis.

COMMENTARY

The identification of a pathological finding underlying the epileptogenic zone may be pivotal in determining operative strategy in patients with symptomatic localization-related epilepsy. Magnetic resonance imaging (MRI) is the most important diagnostic technique in the presurgical evaluation of patients with substrate-directed or lesional epilepsy. Surgically remediable lesional epileptic syndromes include individuals with primary brain tumors, vascular malformations, and malformations of cortical development (MCDs). Patients with lesional epilepsy may experience a significant reduction in seizure tendency subsequent to focal resection of the underlying pathology and the epileptogenic zone. The most common MCDs in patients with intractable partial epilepsy undergoing surgical treatment is focal cortical dysplasia (FCD). Structural neuroimaging studies may be persistently unremarkable in MCD despite the presence of a medically, socially, and physically disabling seizure disorder. The diagnostic yield of MRI in patients with FCD is dependent on the specific histopathology

and lesion location. The MRI findings may be subtle in FCD and require a high index of suspicion based on ictal semiology and the clinical presentation.

The present comparative study by Montenegro et al. evaluates the use of several MRI-based techniques in patients with FCD. MRI, EEG, and clinical findings identified the patients. Three imaging parameters were assessed in 12 patients with the neuroimaging diagnosis of FCD. A high-resolution MRI was compared to two image-postprocessing techniques: multiplanar reconstruction (MPR) and curvilinear reformatting (CR). An individual blinded to the clinical information reviewed the images in the 12 patients with FCD at one center. MPR allows examination of one region of interest in different planes of section. CR may “distinguish subtle lesions from volume-averaging effect.” The rationale for the present study was to determine the comparative diagnostic yield of the techniques in these individuals. MRI demonstrated changes consistent with FCD in six of 12 patients. MPR and CR identified lesions in all patients. The diagnostic yield of CR was subsequently compared with MRI and MPR. CR improved le-

sion localization in one of 12 patients and improved identification of the lesion extent in four of 12 patients. The investigators concluded that these techniques are “complementary” and may be of use in patients with suspected MCD.

The present preliminary study emphasizes the potential limitations of structural MRI in patients with FCD. An unremarkable MRI study may not exclude the presence of a MCD in patients being considered for surgical treatment. The use of MPR and CR may represent an exciting innovation that will alter the presurgical evaluation and operative strategy in patients with intractable localization-related epilepsy. There are significant limitations of image-postprocessing techniques that must be considered. CR “only provides a contour of the hemispheric convexity”; therefore the anatomic localization of the FCD is important. The clinical application of MPR and CR remains to be evaluated in a larger patient group with pathologic findings and at other surgical epilepsy centers. These studies may be time consuming and require additional personnel.

by Gregory D. Cascino, M.D.