Failure of Standard Magnetic Resonance Imaging in Patients With Refractory Temporal Lobe Epilepsy

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Objective: To compare the sensitivity of standard magnetic resonance imaging (MRI) scans done outside an epilepsy center with that of special protocol MRI scans done at an epilepsy center in delineating relevant lesions of the temporal lobe.


Design: The reports of findings on standard MRI scans done outside an epilepsy center were compared with the findings of special protocol MRI scans done with 1.5-mm T1-weighted coronal and 3-mm T2-weighted coronal images (no gaps) on a 1.5-T system. Both sets of MRI findings were compared with findings on histologic examination of the resected tissue.

Results: Of the 84 patients, 51 had standard MRI scans done outside an epilepsy center; of these, there were 34 patients with normal results, 10 with tumors, 2 with vascular malformations, 2 with hippocampal atrophy, 2 with unclassified abnormalities, and 1 with cortical malformation. In 32 of the 34 patients with normal results of an MRI scan done outside an epilepsy center, abnormalities were found on our special protocol MRI scans. These included hippocampal atrophy in 27 patients, tumors in 2, and cortical malformations in 1. Additionally, all 17 of the abnormalities detected on the standard MRI scans done outside the epilepsy center were identified on our special protocol MRI scans. Important pathologic abnormalities of the temporal lobe were identified in 16 (35%) of the 46 patients with standard MRI scans done outside an epilepsy center and in 44 (96%) with our special protocol MRI scans. In the 29 patients for whom adequate surgical specimens were available and results of standard MRI scans were normal, our special protocol MRI scans showed the abnormality in 27 (93%).

Conclusions: Conventional neuroimaging studies are inadequate for diagnosing hippocampal sclerosis although they fairly readily detect low-grade tumors and vascular malformations. Magnetic resonance imaging scans for the evaluation of patients with refractory temporal lobe epilepsy should be done with a special temporal lobe protocol and read by physicians experienced with the findings in hippocampal sclerosis. Health care dollars are wasted on neuroimaging done for refractory temporal lobe epilepsy outside epilepsy centers.

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The diagnosis of hippocampal sclerosis using magnetic resonance imaging (MRI) is an important part of the evaluation of patients with refractory temporal lobe epilepsy. However, we have observed that studies obtained in neuroradiology services not associated with comprehensive epilepsy centers have a low yield in detecting hippocampal abnormalities.

To determine how often relevant hippocampal lesions in patients with refractory temporal lobe epilepsy are missed in MRI scans done outside an epilepsy center, we reviewed the reports of previous neuroimaging of patients referred to us for refractory temporal lobe epilepsy who underwent temporal lobe resection. We compared the findings reported on these standard MRI scans done outside an epilepsy center prior to the evaluation at our center with those on our special protocol MRI scans. The MRI findings were compared with the findings of the histologic examination of the resected tissue.

RESULTS

Of the 84 consecutive patients who underwent temporal lobectomy, 6 patients had no neuroimaging prior to our evaluation; all 6 patients had been treated at our medical center for seizures and underwent their first MRI because of medical intractability. Twenty-seven patients under-
**METHODS**

We reviewed the records and our special protocol MRI scans in 84 consecutive patients who underwent temporal lobe resection for refractory temporal lobe epilepsy between January 1, 1993, and February 1, 1996. The presence of recognized temporal lobe abnormalities on all previous neuroimaging studies was determined from the radiology reports. In a few patients, the radiology reports were not available and the information was abstracted from physicians’ notes or hospital summaries.

The special protocol MRI scans obtained at our center included coronal 1.5-mm T1-weighted and 3-mm T2-weighted images (no gaps) using a 1.5-T superconducting system (Signa, General Electric, Milwaukuee, Wis). During this study, the specific acquisition protocols were modified as new software became available. Some of the scans were obtained after intravenous infusion of 0.2-mL/kg gadopentetate dimeglumine (Magnevist, Berlex Laboratories, Wayne, NJ). Contrast did not appear to influence the interpretation.

The special protocol MRI scans obtained at our center of patients who had standard MRI scans done outside an epilepsy center were reread independently by 2 physicians (M.J.B. and M.C.M.), who were blind to the patients’ identities and unaware of the findings on previous studies or the side of the subsequent temporal lobe surgery. For the 5 patients whose key films were no longer available, we used the reading by 1 physician (M.J.B.) at the time of their admission for monitoring before the monitoring results were known. Each of our MRI scans was rated for hippocampal atrophy and signal changes within the hippocampus and in the anterior temporal lobe white matter. The side of abnormality, if present, was rated on a 5-point scale (1, left; 2, left greater than right; 3, bilateral; 4, right greater than left; and 5, right), and the overall degree of lateralization of the abnormality was rated on a 3-point scale (1, mild; 2, moderate; or 3, severe). The special protocol MRI scan was deemed positive if both readers identified the same side as abnormal or more abnormal than the other. It was deemed negative if both readers identified it as normal or if one reader identified it as normal and the other identified only mild lateralization. Discordance between the readers was prospectively defined as the 2 readers identifying opposite sides as being more abnormal or one describing the scan as normal and the other identifying it as abnormal with moderate or severe lateralization.

After an appropriate evaluation at the epilepsy center,7 each patient underwent a staged, tailored resection of the temporal lobe that included the amygdala and at least the anterior hippocampus. Samples of tissue were obtained at surgery for histologic examination. The predominant pathologic findings were classified as tumor, vascular malformation, hippocampal sclerosis, heterotopic gray matter (cortical malformation), subpial gliosis, or none.

went computed tomography but not MRI outside the epilepsy center. The remaining 51 patients had a total of 69 standard MRI scans as well as 39 computed tomographic scans outside the epilepsy center. Of these 51 patients, 34 had normal results of MRI scans (total of 38 MRI scans and 22 computed tomographic scans with normal results) outside the epilepsy center; however, our special protocol MRI scans in these 34 patients showed abnormalities in 32. The pathologic findings missed on these scans from outside the epilepsy center included 27 with hippocampal sclerosis, 2 with tumors, 2 with unclassified anterior temporal lobe lesions, and 1 with a cortical malformation. The readings of our special protocol MRI scans in these patients were concordant between the 2 readers in all but 1, in which both readers interpreted the MRI scan as indicative of bilateral hippocampal atrophy but disagreed on which side was more abnormal. The abnormalities found on the standard MRI scans from outside an epilepsy center in 16 of the remaining 17 patients were confirmed on our scans and from pathologic examination. In one patient, for whom the outside scan showed hippocampal atrophy on one side, our special protocol MRI scan showed more important pathologic findings on the other side that were confirmed by histologic examination of the resected tissue.

Adequate pathologic findings were not available in 5 of the 34 patients. In 3 of these, the hippocampus was not identifiable in the tissue samples sent for pathologic examination, but gliosis or heterotopic neurons were present, and the patients did not have seizures postoperatively, suggesting that hippocampal abnormalities were present. In the other 2, anterior mesial temporal lobe lesions were present on the special protocol MRI scan. Presumably these lesions were removed by suction during the staged resection and thus were not included in the samples sent for pathologic examination. In 27 of the 29 patients with adequate specimens, the MRI findings matched the pathologic findings found at surgery. In the other 2 patients, the hippocampus was rated as normal on our special protocol MRI scans; however, on pathologic examination, hippocampal sclerosis was present in one and a cortical malformation in the other.

Adequate pathologic specimens were available in 46 of the 51 patients included in this study who had standard MRI scans from outside an epilepsy center prior to referral. In these 46 patients, the frequency of identifying the pathologic findings was 16 (35%) with MRI scans performed outside an epilepsy center and 44 (96%) with MRI scans performed according to our protocol. In the 29 patients with adequate pathologic specimens and standard MRI scans with normal results performed outside an epilepsy center, our special protocol MRI scans showed the pathologic findings in 27 patients (93%).

**COMMENT**

We found significant abnormalities on our special protocol MRI scans in 93% of patients who underwent operations for refractory temporal lobe epilepsy whose results of standard MRI performed outside an epilepsy center were reported as normal. Among the entire group of 51 patients who underwent MRI outside an epilepsy cen-
ter, abnormalities were identified on only 35% of the scans compared with 96% of our special protocol MRI scans. In this study, we did not review the special protocol MRI scans of the temporal lobe in the 24 patients who had normal results of computed tomographic scans but did not undergo MRI outside an epilepsy center. Had we done so, it is likely that we would have found a similarly high percentage of abnormalities in that group.

In this study, we did not define whether scan technique or interpretation was the cause of missed abnormalities in the standard scans performed outside an epilepsy center because those scans were no longer available to us for review. However, we reviewed most of those scans at the time the patients were referred. Those scans were not done with thin, closely spaced cuts, and only occasionally did we detect previously unidentified pathologic characteristics. Additionally, even experienced neuroradiologists missed the temporal lobe abnormalities in our special protocol scans in patients with refractory temporal lobe epilepsy when they were not accustomed to the nature of these abnormalities. In this study, there was nearly complete concordance between the 2 readers experienced in interpreting special protocol MRI scans. We believe that both high-quality protocol MRI scans of the temporal lobe and interpretation by physicians experienced with temporal lobe abnormalities are needed for optimal care of patients with refractory temporal lobe epilepsy.

The rate of missed abnormalities on standard MRI scans performed outside an epilepsy center may have been lower in a group of patients with refractory temporal lobe epilepsy who did not undergo surgery because it is likely that fewer of them would have had findings on special protocol MRI scans. Although we recognize this bias, we chose to review only the surgical group so that we could correlate our findings with the pathologic findings. This correlation demonstrated the high degree of accuracy of the findings on our special protocol MRI scans.

Patients with lesions identified on MRI scans performed outside an epilepsy center should have special protocol MRI scans done prior to surgery. Lesions are far better defined on the special protocol MRI, enabling the surgeons to guide their resections based on knowledge of the relationship of the lesions to the mesial temporal structures and the extent of possible coexistent hippocampal sclerosis.

We found 2 tumors that had not been diagnosed on scans performed outside the epilepsy center. The tumors were small, low-grade astrocytomas within the mesial temporal area. Identification of these tumors is important because they were the cause of the patient’s refractory epilepsy. Missing such lesions on the standard scans performed outside an epilepsy center is probably not important until the patient’s seizures become refractory to the use of 1 or 2 antiseizure medications. However, the knowledge that patients have a mesial temporal lobe tumor when their seizures are proving refractory should lead to early referral for evaluation for epilepsy surgery because these patients have excellent seizure control after epilepsy surgery. 

Although MRI techniques continue to improve everywhere, the differences remain great between scans performed outside an epilepsy center and those done specifically for patients with refractory epilepsy in comprehensive epilepsy centers. Each epilepsy center uses slightly different MRI techniques to identify abnormalities of the temporal lobe, but the techniques almost always include thin contiguous cuts in the coronal plane, and the sensitivity to abnormalities of the temporal lobe is similar among these centers. Third-party payers are increasingly reluctant to reimburse for imaging studies done by other than their designated providers, but we strongly believe that insurers should review their policies. Our findings indicate that standard MRI scans obtained outside a comprehensive epilepsy center have a low sensitivity for diagnosing important lesions in contrast to the high sensitivity of MRI scans done with special temporal lobe protocol within a comprehensive epilepsy center; therefore, health care dollars are wasted on standard MRI in these patients.

In conclusion, standard neuroimaging studies are poor for diagnosing hippocampal atrophy, although they fairly readily detect tumors and vascular malformations. Magnetic resonance imaging for the evaluation of patients with refractory temporal lobe epilepsy should be done using a special temporal lobe protocol and read by physicians experienced with the findings in hippocampal sclerosis. Health care dollars are currently being wasted on neuroimaging studies for refractory epilepsy done outside epilepsy centers.

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REFERENCES