The Use of Magnetic Resonance Spectroscopy in the Evaluation of Epilepsy in Pediatric Patients

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Target Audience: Neuroradiologists (Pediatric Neuroradiologists), Neurologists (Child Neurologists), MR Physicists, MR Spectroscopists

Purpose: Neuroimaging plays an essential role in the evaluation of the pediatric patient with seizure. The goal of neuroimaging is to detect certain treatable epileptogenic conditions such as tumors, hemorrhage, vascular malformations, or inborn errors of metabolism that would prompt involvement of the neurosurgical, neurointerventional, metabolic or genetic services in the patient's management [1]. MRI has been considered an essential neuroimaging tool to reach this goal (e.g. [2] and [3]). Over the last 20 years, magnetic resonance spectroscopy (MRS) has progressed from a research tool with clinical potential to a clinically applicable, noninvasive diagnostic tool [4]. MRS can provide useful information in screening for metabolic derangements that may occur from seizure, screen for certain metabolic disorders that may present with seizures (e.g. mitochondrial disorders, creatine deficiency), characterize masses detected by conventional MRI as dysplasia versus neoplasm, and lateralize an epileptogenic nidus in temporal lobe epilepsy when conventional MRI is negative [1]. In neonatal encephalopathy/HII, MRS may also provide prognostic information [5] [6]. The evidence basis for MRS is still growing, and to that end, the purpose of our study was to retrospectively evaluate MRI, MRS, and clinical data to determine how often MRS added information to conventional MRI for evaluation of seizure in pediatric patients.

Methods: A database search was performed to identify patients <18 years old with both MRI and MRS for evaluation of seizure for a 3 year period between 1/1/2011 and 12/31/2013. Search terms included "epilepsy" or "seizure" or "EEG" or "status epilepticus" or "convulsions" and "spectroscopy". This search yielded 249 cases (229 unique patients). Eight cases were discarded because the MRS was nondiagnostic, leaving a total of 241 cases. All MRI/MRS data had been acquired on either a 3T Siemens or a 1.5 GE scanner. The following MRS pulse sequences have been used: 143 patients had single voxel spectroscopy (SVS), 90 patients had magnetic resonance spectroscopic imaging (MRSI) and 9 patients had both. Eighty one patients had short TE (30 ms – 40 ms) MRS, 22 had long TE (either 144 or 288 ms) MRS but most patients (138 cases) had both, short TE and long TE MRS acquisitions. Chart review was performed to determine if patients had a relevant diagnosis known at the time of imaging. We defined relevant diagnosis as a diagnosis related to seizure and known to exhibit structural MRI features. MRI, MRS, and original radiology report were reviewed by 2 neuroradiologists and an MR physicist, to determine whether MRS was normal or abnormal for the patient's age, and whether MRS added information not provided by MRI. We defined "added information" as increasing diagnostic confidence OR abnormal findings that provoked additional thought or testing.

Results: MRS yielded additional information for 40% (96/241) of all cases, 63% (49/78) of cases with a known relevant diagnosis, and 29% (47/163) of cases with no known relevant diagnosis at the time of imaging. MRS was most helpful when found to be abnormal (76/86 cases (88%).

For all cases, the largest subsets of patients that had MRS exams yielding additional information were patients

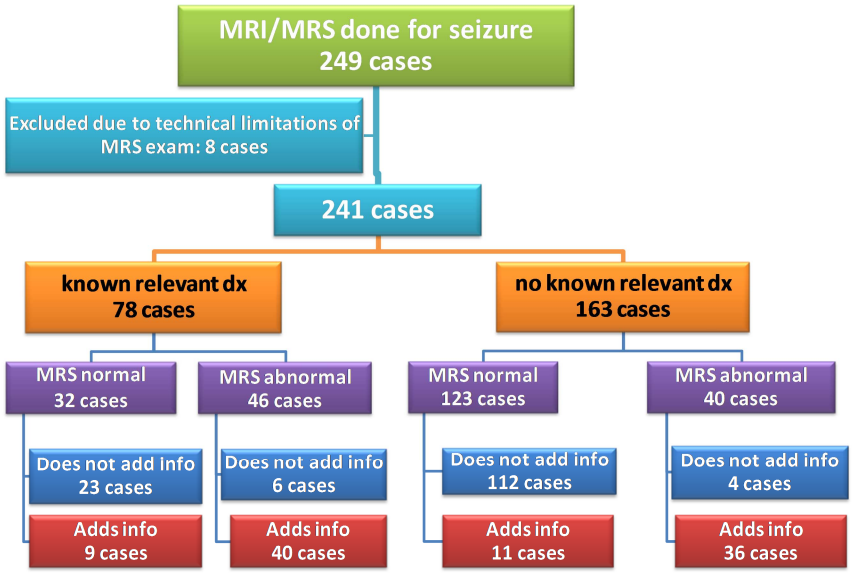
- with HII (17/96),
- distinguishing dysplasia from neoplasm (15/96),
- and MRS abnormalities prompting metabolic or genetics workup (15/96).

Of patients with a known diagnosis, the largest subset of patients that had MRS exams yielding additional information were patients with hypoxic ischemic injury (HII) (15/49).

Of patients without a known diagnosis, the largest subset was patients with MRS abnormalities that prompted metabolic or genetic workup (11/47).

Interestingly, of 74 patients that had clearly normal MRI findings 14 patients (19%) showed abnormal MRS findings. The majority of these patients revealed an elevated lactate peak which raised concern for inborn errors of metabolism and resulted in a metabolic and genetic workup.

Of note, cases where a normal MRS provided reassurance were not counted towards "added information". If so, the number of cases adding information would have been even higher.



Discussion:

In our series, MRS provided additional information in 40% of pediatric patients with seizures. It added information more frequently for patients with a known diagnosis vs. patients without a known diagnosis at the time of imaging. Adding MRS was particularly helpful in cases of HII with regard to prognosis [5] (e.g. redirection of care), distinguishing dysplasia from neoplasm and prompting additional clinical workup.

Conclusion: In select pediatric patients evaluated for seizure, MRS can add information that is not provided by MRI.

References:

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