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Case Report

Periictal MRI Findings of Hypervascularity with Restricted Diffusion Contralateral to Gaze Deviation

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Abstract

We present a case report of a child who had a seizure that began during a Magnetic Resonance Image (MRI) scan of her brain. The MRI showed restricted diffusion on Apparent Diffusion Coefficient (ADC) and increased perfusion on Maximum Imaging Projection (MIP) sequence correlating with the area of ictal discharges on electroencephalogram (EEG). Neuroimaging has become crucial in the diagnosis and understanding of seizures, however correlating it with an acute seizure is seldom able to be obtained. In particular, MRI sequences such as Diffusion Weighted Image (DWI), ADC, fluid attenuated inversion-recovery (FLAIR) and MIP images have proven useful in determining the extent and severity of cortical injury in various disease processes.

Introduction

It has long been known that hemodynamic changes occur in the brain during a seizure. In periictal MRI, changes in intracerebral perfusion dynamics have allowed us to localize and determine etiologies for epilepsy, although it is difficult to come across such studies given the unpredictable nature of seizures. Due to timing, it is difficult to understand what is happening in the anatomical brain during a seizure. However, we present a case of a seizure that started during an MRI scan. Seizure semiology may help lateralize the seizure focus, as shown by a cohort study which found that unilateral head/eye deviation predicted contralateral ictal focus in 67% of seizures [1]. One study described hyper-perfusion changes in areas involved in focal epilepsy with notable changes on DWI and ADC [2]. Huang et al, found that serial DWI and FLAIR images proved useful in determining the extent and severity of early neuronal damage associated with epileptic discharges in patients with status epilepticus [3]. These findings were also supported by Bonaventura et al. who described transient DWI changes in the area of seizure focus which took up to 90 days to resolve once the seizures resolved [4].

Case Report

A 5-year-old girl was brought to the Emergency Department (ED) for new onset seizures. She was a previously healthy, fully vaccinated and developmentally normal child. Two days prior to admission she developed vomiting, diarrhea and poor appetite. At home, she was lying next to her father on the couch when he woke up and found her unresponsive, with stiff extremities and her eyes open and rolled back. The episode lasted about 10-15 minutes. She was taken to the nearest ED for evaluation. Her parents denied any tonic clonic activity, no urinary incontinence, no tongue biting. She had a temperature of 38.4 C and was admitted for observation. A lumbar puncture revealed an elevated WBC of 22 (Neutrophils 17%, Lymphocytes 61%) with 1 RBC, a protein of 22 mg/dl and glucose of 66 mg/dl. Upon admission, the patient had a similar episode of body stiffening requiring two doses of lorazepam 1mg/kg and a fosphenytoin load of 20mg/Kg. The following day an EEG revealed mild to moderate generalized background slowing without paroxysmal activity. Levetiracetam was initiated at a dose of 30mg/kg/day divided twice daily. On day two of admission, she continued to have altered mental status with new onset of non-purposeful movements of her extremities and could not follow simple commands.

An MRI brain with and without contrast was ordered for further evaluation (Figure 1A, 1B, 1C). She required light sedation for the MRI and therefore was taken to the Post Anesthesia Care Unit (PACU) upon completion of the study. Upon arrival to PACU, she was noted to unresponsive with forced eye deviation to the left. The episode resolved with an emergent dose of lorazepam 2mg and a fosphenytoin load of 20mg/kg. Continuous video EEG monitoring was initiated and showed right fronto-temporal Periodic Lateralizing Epileptiform Discharges (PLEDS) (Figure 2). A review of the MRI was significant for restricted diffusion, mostly on the right side compared to the left, concerning encephalitis versus ictal changes given the distribution, however there

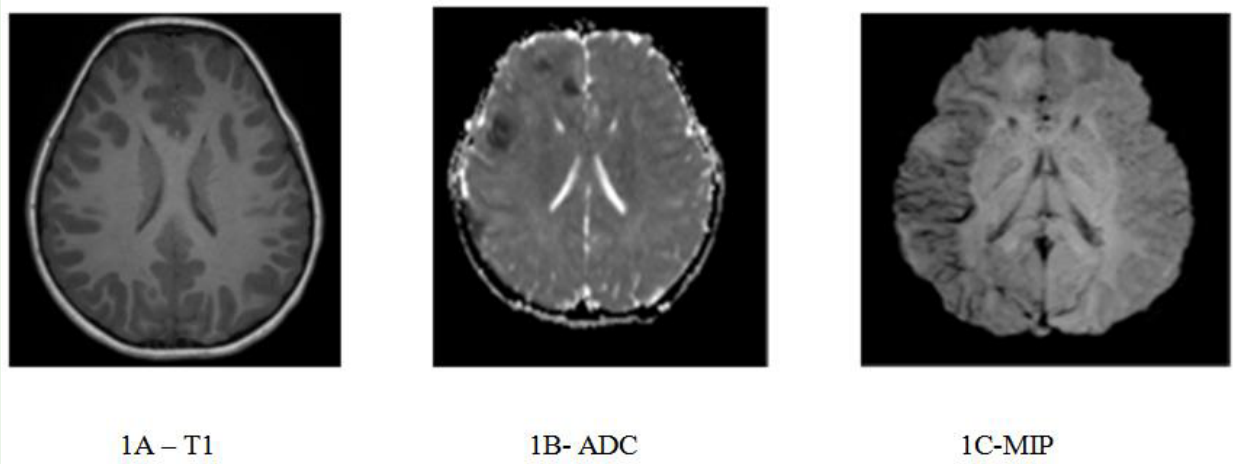

Figure 1A: T1 weighted images of her MRI brain were unremarkable.
Figure 1B: ADC shows restricted diffusion in the right hemisphere.
Figure 1C: MIP demonstrating increased perfusion in the right hemisphere.

Figure 2: EEG: Right fronto-temporal Periodic Lateralized Epileptiform Discharges (PLEDS): Rhythmic spike and wave discharges were seen in the right hemisphere, maximum in the right temporal head region T4/T6, about once per second.

was also a consideration of an ischemic insult, though less likely. MRI susceptibility weighted sequence demonstrated darker vessels throughout the right hemisphere compared to the left indicative of increased blood flow in the right hemisphere. The MRI, EEG and clinical findings support a diagnosis of encephalitis with ictal changes and suggest that she likely began seizing during her MRI scan.

Over her hospital course, the patient had progressively worsening encephalopathy with seizures requiring multiple rescue medications and was eventually started on phenobarbital and fosphenytoin maintenance, along with continuing her levetiracetam. She also developed Increased Intracranial Pressure (ICP) with max pressure of 30mmHg, requiring multiple doses of mannitol, versed, fentanyl and eventually vecuronium to bring her ICP to less than 15 mmHg. After achieving seizure control her fosphenytoin was discontinued and she was maintained on phenobarbital and levetiracetam which she continued upon hospital discharge. To date, the cause of her encephalitis remains unknown, with negative serum and CSF bacterial, fungal and viral cultures. However, the patient is now able to participate in activities of daily living, speaks in full sentences, is attending school and is seizure free. She continues to have mild behavioral difficulties and inattention issues, but is responding well to therapy.

Discussion

In our case, the patient was found to have forced eye deviation to the left correlating with right temporal lobe PLEDs. The periictal MRI findings of restricted diffusion, local edema and hypervascularity in the region of seizure focus supports the theory that during a seizure there is increased metabolic demand at the cellular level resulting increased blood flow [5-9]. While this case report provided a unique look at the dynamic changes that occur at the cortical level of during a seizure, we recognize that this is an isolated event and not easily reproducible. Further studies, including Functional MRI or Single Photon Emission Computed Tomography (SPECT) may be useful in detailing the metabolic and biochemical demand at the cellular level and aid in further localization of the ictal focus is epilepsy patients [10-12].

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