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The Role of High-Field-Strength Magnetic Resonance Imaging in Mesial Temporal Lobe Epilepsy

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Abstract

Mesial temporal lobe epilepsy is the most common pharmaco-resistant epilepsy where surgery has an important role. A multidisciplinary team coordination between different neuroscientists including psychiatrists and psychologists is needed to effectively correlate all the clinical, pathological, electrophysiological, and radiological data to better manage patients with refractory epilepsy. Patients with mesial temporal lobe epilepsy usually remain seizure-free after surgical resection. We present a case of mesial temporal lobe epilepsy where 1.5 Tesla magnetic resonance imaging showed no changes in mesial structures. Based on the strong suspicion of temporal lobe asymmetry due to the correlation between the typical ictal semiology and the electrophysiological changes in video electroencephalogram (EEG), a 3.0 Tesla magnetic resonance imaging was performed and evidenced the temporal lobe asymmetry. This case shows the value of high field strength in magnetic resonance imaging for mesial temporal lobe epilepsy for adequate qualitative analysis of mesial structures in typical clinical-electrophysiological cases of mesial temporal lobe epilepsy where 1.5 Tesla magnetic resonance imaging shows no evident lesion.

Keywords: Biopsy, magnetic resonance imaging, mesial temporal lobe epilepsy, anteromesial temporal resection, video-elec troencephalogram

Introduction

A multidisciplinary approach should be taken in mesial temporal lobe epilepsy (MTLE) since it is the most common pharmaco-resistant epilepsy where surgery of the evidenced temporal lobe asymmetry can leave the patient seizure-free.

Case Presentation

A 25-year-old right-handed woman was admitted to our hospital for refractory epilepsy. The patient had a history of febrile convulsions since the age of 2 years, which progressed to partial complex seizure with secondary generalization afterward. By early adulthood, the patient has had an increase in the frequency of seizures and has become resistant to different schemes of antiepileptic drugs (AEDs). Previously used AEDs like phenobarbital, carbamazepine, lamotrigine, and levetiracetam have failed to maintain a seizure-free state for the patient, either in combination or as a sole therapy. At the time of referral, the patient was under carbamazepine 800 mg/day. The frequency of seizures was between 8 and 10 per month at the time of presentation. The neurological examination showed no focal deficits. The patient's seizure episodes usually started focally and then progressed to a generalized convulsion with a duration of 2 to 4 minutes. The postictal period was characterized by mental confusion, memory lapses, episodes of urinary incontinence, and tongue biting. A standardized presurgical evaluation protocol in order to assess the eligibility for anteromesial temporal resection (AMTR) was conducted, and the patient was considered for surgery by our multidisciplinary team. The psychiatric evaluation of the patient showed normal neuropsychological analysis. Video electroencephalogram (EEG) demonstrated the electrophysiological changes with the ictal semiology (Figure 1) that consisted of aura with thoracic constriction, conscience alteration, oroalimentary automatisms, non-versive head rotation to the left (ipsilateral to the lesion), left-hand automatism, and secondary generalization with tonic-clonic contraction, urinary incontinence, and tongue biting.

Imaging studies before intervention in 1.5 Tesla MRI of the brain performed by the epilepsy protocol showed no asymmetry in the hippocampal structures. Whereas in the coronal section of 3.0 Tesla MRI, a hypersignal in FLAIR sequences in the left hippocampal structures consistent with mesial temporal lobe epilepsy was noticed (Figure 2).

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Through an extended left pterional craniotomy under an operatory microscope, an AMTR was successfully performed without any periprocedural or post-op complications. The patient was considered ENGEL class IA/IB post-op, and several neuropsychiatric tests resulted normal.

Four specimens were taken as shown in Figure 2 and focal loss of neurons in the hippocampus was consistent with hippocampal sclerosis. Macroscopy of various specimens is taken as shown in Figure 3.

The microscopy of the above specimens is shown in Figure 4, and it shows focal loss of neurons in the hippocampus which is consistent with hippocampal sclerosis.

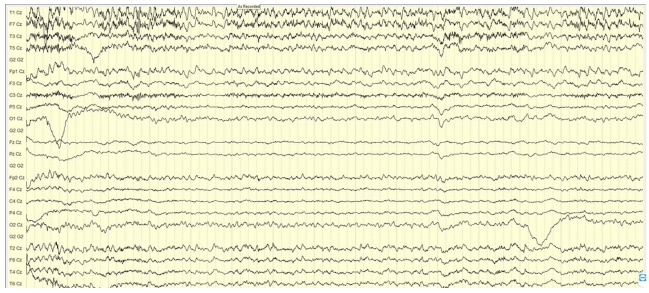

Figure 1. The ictal phase starts with theta rhythmic activity in the anterior temporal lobe T7-temporal basal T1 with a frequency of 6-7 Hz, and it suggests the start of the ictal phase at the left mesial structures. Under these conditions, the decision was to surgically treat this patient with anterior temporal lobectomy.

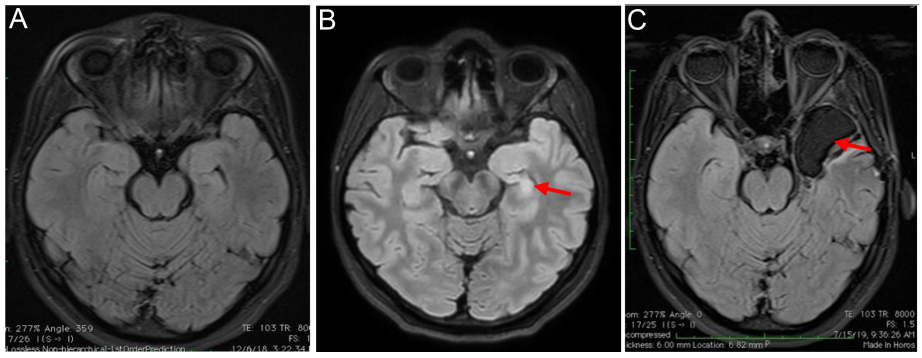

Figure 2. (A) Axial 1.5 Tesla MRI before intervention showed no evident lesions in left mesial temporal lobe. (B) Axial sections in 3.0 Tesla MRI–FLAIR sequences of the left hippocampal structures showed a hypersignal and hippocampal volume loss in quantitative analysis resulting in an asymmetry between the 2 mesial temporal lobes. (C) Axial sections in 3.0 Tesla MRI–FLAIR sequences of the left hippocampal structures post-op cavity. MRI, magnetic resonance imaging.

Main Points

- This article shows the value of higher resolution magnetic resonance imaging (MRI) in mesial temporal lobe epilepsy (MTLE) for quantitative analysis of mesial structures in typical clinical-electrophysiological cases of MTLE where 1.5 Tesla MRI shows no evident lesion.
- The clinician's role is evident in cases where there is a strong correlation between electrical and clinical studies where imaging fails to contribute correctly in time.
- Patients experiencing intractable seizures due to pharmaco-resistant epilepsy have impaired cognitive functions especially if they have a history of childhood seizure onset or a history of febrile convulsions as our patient experienced. A thorough psychiatric evaluation is needed prior to surgery and after surgery.
- In the follow-up, our patient was ENGEL class IA/IB post-operatively showing a better outcome than pharmacotherapy in the long term. Surgery is still superior to pharmacotherapy in relation to seizure outcomes for MTLE and we demonstrate this with the case.
- A multidisciplinary team coordination between different neuroscientists including psychiatrists and psychologists is needed to effectively correlate all the clinical, pathological, electrophysiological, and radiological data to better manage patients with refractory epilepsy.

Discussion

Mesial temporal lobe epilepsy is the most common pharmaco-resistant epilepsy where surgery has an important role.[1] Seizure semiology according to the International League Against Epilepsy (ILAE) has a recent classification system for epilepsies to emphasize the etiologic basis of the patient's condition.[2] Now there is a better understanding of different underlying mechanisms of actions of epileptogenic foci and this is crucial in making rational treatment decisions. Poor seizure control despite different schemes of AEDs either combined or as a stand-alone therapy has been related to MTLE. Based on the latest ILAE classification, patients with MTLE usually are classified as having focal epilepsy and manifest as focal onset seizures with or without impaired awareness.[3,4] In cases with preserved awareness, the patient can describe visceral, autonomic, gustatory, or affective symptoms known as auras. Our patient experienced a raised epigastric sensation, nausea, and olfactory and/or gustatory hallucination. In other cases, psychiatric phenomenon can occur, such as depersonalization, déjà-vu/jamais-vu/déjà-entendu, or panoramic visions. Dysphoric or euphoric feelings, fear, terror, anger, and other sensations can also occur. Often, the patients find the aura hard to describe. Autonomic features include piloerection, pallor/flushing, tachycardia, or pupillary dilatation.[4] In other cases where a loss of awareness can occur, patients have a behavioral arrest and portray a

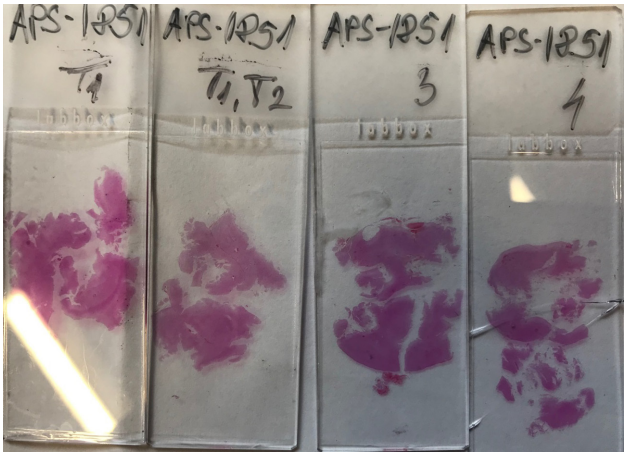

Figure 3. A piece of brain tissue measuring 30 × 20 × 18 mm in T1 pole. A piece of brain tissue measuring 28 × 22 × 18 mm in the 12-13 cortex. A piece of brain tissue measuring 26 × 26 × 17 mm in the para-hippocampal gyrus. A piece of brain tissue in the hippocampus body measuring 14 × 12 × 12 mm.

blank staring facial appearance, which is followed by the development of oro/facial/alimentary automatisms such as lip-smacking, chewing, sucking, or swallowing, which is usually accompanied by ipsilateral gestural automatisms such as repetitive hand movements, picking and/or fidgeting behavior, disrobing, and contralateral dystonic posturing of limbs. The presence of speech suggests non-dominant hemispheric seizure onset, but its absence is not a reliable lateralizing outcome. Patients commonly have a period of postictal confusion following the episode. Less commonly, episodes may progress to generalized tonic-clonic seizures as in our case.[5,6] Overall, patients with MTLE have a reduced quality of life due to poorly managed seizures leaving them sometimes with cognitive impairment, a higher risk for a sudden unexpected death, and psychiatric disorders such as anxiety or depression. Surgery was superior to pharmacotherapy in relation to seizure outcome for MTLE according to Engel et al[7] in the Early Randomized Surgical Epilepsy Trial (ERSET). The evidence released by ERSET strongly suggested that surgery also improved the quality of life and the ability to drive and socialize.[3,8] In the follow-up, our patient was ENGEL class IA/IB post-operatively showing a better outcome than pharmacotherapy in the long term. Patients experiencing intractable seizures due to pharmaco-resistant epilepsy have impaired cognitive functions especially if they have a history of childhood seizure onset or a history of febrile convulsions as our patient experienced.[9] The MRI quantitative analysis of hippocampal structures increases the sensitivity for detecting MTLE with hippocampal sclerosis. In tertiary epilepsy centers with advances in the imaging field in the past decades, progress has been made not only in the early detection of hippocampal pathology but also in the prompt management of these patients contributing to a seizure-free state and increased quality of life. However, the clinician role is evident in cases where there is a strong correlation between electrical and clinical studies where imaging fails to contribute correctly in time. Our case shows the value of higher resolution MRI in MTLE for quantitative analysis of mesial structures in typical clinical-electrophysiological cases of MTLE where 1.5 Tesla MR shows no evident lesion.[5,10] A cautious correlation of neuroimaging studies of 3.0 Tesla MRI and electrophysiological studies was achieved in our case showing the value of 3.0 Tesla MRI in cases with refractory epilepsy with a negative 1.5 Tesla MRI study.[11,12] Clinicians should follow to order high-resolution MRI studies in all suspected clinical cases with refractory epilepsy with the clinical picture of MTLE and additive ictal localization with electrophysiological studies in order to not miss hippocampal sclerosis with lower resolution machines.

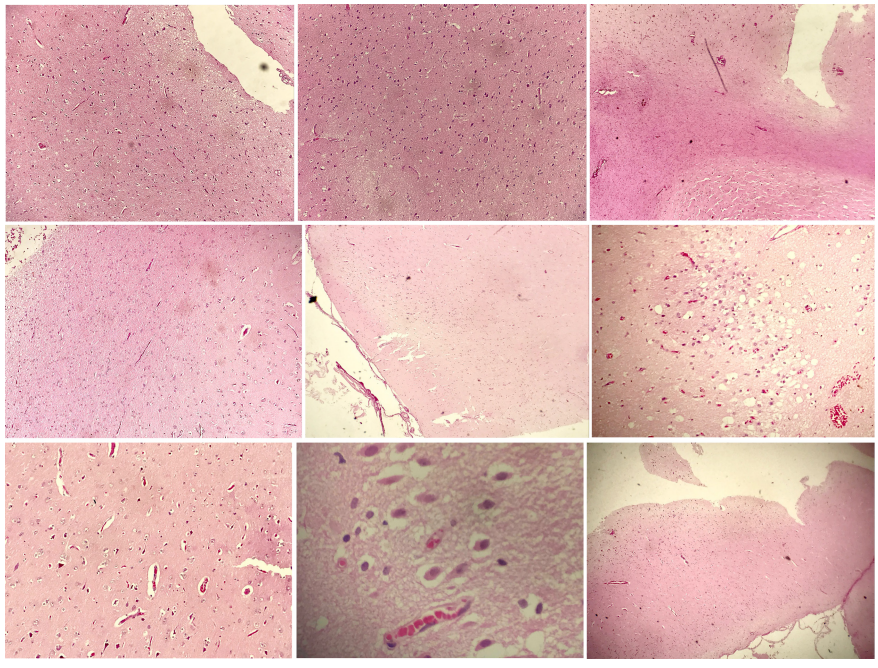

Figure 4. Sections show cortical brain tissue with no evidence of dyslamination, dysmorphic neurons, and cortical dysplasia. The white matter appears normally myelinated. The hippocampus shows a focal neuronal loss. There is no evidence of an inflammatory process or evidence of tumor.

Conclusion

A cautious correlation of neuroimaging with 3.0 Tesla MRI and video EEG is required in MTLE cases with intractable seizures. The role of high-resolution MRI in MTLE is evident and goes alongside the high clinical suspicion and electrophysiological studies correlation. Even though MTLE is a well-studied syndrome, this case adds up to the literature by further emphasizing the clinician's role in diagnosis when radiological studies fail to contribute correctly in time.

Informed Consent: Written Informed consent was obtained from the patient who participated in the surgical procedure, although there is no identifiable patient information.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – E.R., F.D.; Design – E.R., F.D; Supervision – E.E., M.P.; Materials – A.S., F.D. A.RR; Data Collection and/or Processing – A.S., E.E., E.R; Analysis and/or Interpretation – M.P., E.R., F.D; Literature Review – E.R., F.D.; Writing – E.R., F.D.; Critical Review – M.P., A.RR.

Declaration of Interests: The authors have no conflict of interest to declare.

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