RESEARCH PAPER

Rasmussen Encephalitis Presenting as Drug-Resistant Focal Epilepsy in an Adolescent: A Case Report with Narrative Review

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ABSTRACT

Background:

Rasmussen encephalitis, a rare and progressive inflammatory condition of the brain, is distinguished by its unilateral hemispheric manifestation, the presence of medically intractable focal seizures, and a progressive deterioration of neurological function. Prompt identification is crucial to enable the initiation of immunotherapy and the evaluation of surgical options.

Case Presentation

A 14-year-old boy, who had been healthy before, came to the hospital with a history of focal motor seizures that had been happening for eight months. These seizures, which started in the right arm, became more frequent and then developed into focal impaired-awareness seizures, sometimes followed by generalized tonic clonic seizures. Despite trying different anti convulsants including levetiracetam, valproate, and clobazam, the seizures weren't well-controlled. Over time, the patient showed increasing weakness on the right side, along with problems with fine motor skills and a decline in scholastic performance. An electroencephalogram (EEG) showed ongoing epileptiform activity and focal slowing in the left cerebral hemisphere. An MRI scan showed atrophy of the left hemisphere and marked ventricular dilatation and marked loss of cortical volume favouring the findings of rasmussen's encephalitis

Management:

The patient received high-dose corticosteroids, followed by intravenous immunoglobulin therapy. This treatment led to a temporary and partial reduction in the frequency of seizures. Because of the ongoing seizures and the worsening neurological problems, an evaluation for functional hemispherotomy was started.

Conclusion:

This case highlights the importance of recognizing Rasmussen encephalitis in adolescents who have progressive focal epilepsy and neurological dysfunction with long lasting unilateral inflammation of cerebral cortex leading to seizures and which is refractory to treatment and it progresses as prodormal phase, acute phase where there is neurological decline and late residual phase. Early diagnosis, along with a quick surgical evaluation, is essential for improving long-term neurological outcomes.

Keywords: Rasmussen encephalitis; drug-resistant epilepsy; focal seizures; hemispheric atrophy; immunotherapy; hemispherotomy

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INTRODUCTION

Rasmussen encephalitis (RE), a rare, long-lasting inflammatory disease of the brain's outer layer, is characterized by the gradual worsening of one side of the brain, leading to seizures that don't respond to treatment. The condition was first described in 1958 in patients who had focal seizures along with long-term localized encephalitis affecting one hemisphere.[1]

Although the disease mainly affects children and teenagers, cases in adults have also been reported. Clinically, RE usually progresses through three stages: a beginning phase with relatively few seizures, an acute phase marked by more frequent seizures and neurological problems, and a residual phase where permanent neurological damage remains even after the inflammation has stabilized.[2],[3]

Seizures associated with Rasmussen encephalitis are typically focal and can become epilepsia partialis continua in advanced cases. Depending on which hemisphere is affected, the progression of seizures often leads to weakness on one side of the body, cognitive decline, and language difficulties.[3]

Electroencephalography often shows abnormal brain activity on one side and localized slowing in the hemisphere affected.

Neuroimaging, particularly magnetic resonance imaging, plays a central role in diagnosis by demonstrating progressive hemispheric atrophy, cortical signal changes, and ventricular enlargement.[4–6]

Although the exact pathogenesis remains incompletely understood, accumulating evidence suggests that cytotoxic T-cell–mediated immune mechanisms play a critical role in neuronal injury and cortical destruction.[7] Immunomodulatory therapies may temporarily reduce seizure burden, but many patients ultimately require surgical intervention to achieve meaningful seizure control. Functional hemispherotomy has emerged as the most effective treatment for advanced or drug-resistant cases.[8]

This report describes an adolescent presenting with progressive focal epilepsy subsequently diagnosed as Rasmussen encephalitis and provides a narrative review of current understanding regarding its clinical features, diagnostic evaluation, and management.

Case Presentation

A 14-year-old boy with no prior medical history was brought to the neurology clinic with recurrent episodes of involuntary jerking of the right upper limb that had begun eight months earlier. The episodes initially lasted less than one minute and occurred several times per week. During these events the patient remained conscious and was able to recall the episodes afterward. Over the following months, the frequency of seizures increased significantly, and the semiology evolved into focal impaired-awareness seizures that occasionally progressed to generalized tonic–clonic seizures. The patient was administered levetiracetam, and subsequently sodium valproate and clobazam were added due to persistent seizures. Despite combination therapy, the seizures remained poorly controlled. Five months after the seizures started, the patient showed a pattern of increasing weakness in the right hand. This was accompanied by difficulty with fine motor skills, such as writing and manipulating small objects. In addition, family members reported a shorter attention span and a decline in academic performance. On neurological examination, the patient was alert and oriented. Cranial nerve examination was normal. The motor examination showed slight weakness in the right arm and leg, along with reduced grip strength and impaired coordination. However, the sensory examination did not show any unusual findings. Electroencephalography showed frequent epileptiform discharges and focal slowing, mainly in the left hemisphere, suggesting a single area of seizure activity. Brain magnetic resonance imaging showed progressive cortical atrophy in the left cerebral hemisphere, along with unilateral ventriculomegaly. T2-weighted and FLAIR imaging sequences revealed bright signal changes, primarily affecting the left frontotemporal cortex. Routine laboratory investigations, including metabolic and infectious evaluations, were within normal limits. Considering the progressive clinical course, unilateral radiological findings, and medically refractory seizures, a diagnosis of Rasmussen encephalitis was established according to diagnostic criteria.[2] The patient was treated with high-dose corticosteroids followed by intravenous immunoglobulin therapy. Although a temporary reduction in seizure frequency was observed, the improvement was incomplete and short-lived. As neurological deficits continued to progress, the patient was referred to a tertiary epilepsy center for further evaluation and consideration of functional hemispherotomy.

Narrative Review of Current Evidence

Epidemiology and Clinical Presentation

Rasmussen encephalitis is an uncommon neurological condition characterized by progressive inflammation affecting unilateral cerebral hemisphere. Although cases have been reported across different age groups, the disorder most frequently presents during childhood or adolescence. Patients usually develop focal seizures at the onset of the disease, which gradually increase in frequency and may eventually become resistant to conventional anti epileptic medications.[3] Previous studies have described focal motor seizures involving a single limb as a common early manifestation. Varadkar et.al observed that seizures, while potentially appearing benign at first, frequently escalate in frequency as the inflammatory process intensifies within the impacted hemisphere.[3] This progression was demonstrable in the current case study; the patient initially exhibited focal clonic movements localized to the right upper limb, which subsequently developed into more intricate seizure types, accompanied by neurological impairments.

Pathophysiological Mechanisms

Despite several decades of research, the precise cause of Rasmussen encephalitis has not been fully clarified. Current evidences, however, strongly suggests that the disease is caused by an immune system-related inflammatory process in the cerebral cortex. Bien et al. Cytotoxic T-lymphocytes have been posited as key players in neuronal damage, initiating the progressive degeneration of cortical tissue within the impacted hemisphere.[2] In corroboration of this hypothesis,

analyses of tissue specimens have revealed the infiltration of inflammatory cells and the loss of neurons within the affected brain regions. Alvarez-Barón et al. observed autoantibodies and immune cell activation within the cortical tissue of Rasmussen encephalitis patients, thereby reinforcing the significance of immune mechanisms in the disease's advancement.[10] Consequently, these inflammatory processes are thought to compromise neuronal networks, thereby contributing to the gradual neurological deterioration observed in affected individuals. Neuroimaging is crucial for diagnosing Rasmussen encephalitis. Magnetic resonance imaging often shows progressive structural changes in the affected hemisphere. These changes include cortical atrophy, enlarged ventricles, and signal abnormalities in cortical or subcortical areas.[6] Chiapparini and colleagues showed that MRI abnormalities can be seen early in the disease, providing helpful diagnostic information before significant hemispheric atrophy occurs.[6] Quantitative imaging studies have also shown that structural changes can extend beyond the most visibly affected cortical areas. Wagner et al. found that automated volumetric MRI analysis can identify specific patterns of regional brain atrophy associated with Rasmussen encephalitis.[8] In addition, electroencephalographic findings provide important diagnostic information. Electroencephalogram (EEG) recordings usually show unilateral slowing and epileptiform discharges in the hemisphere affected. Longaretti and colleagues described how EEG abnormalities can gradually appear as the illness progresses, reflecting the spread of cortical dysfunction.[4] The imaging and electrophysiological findings in our patient were consistent with these previously reported characteristics.

Medical Management

The management of Rasmussen encephalitis remains complex because seizures often become resistant to standard antiseizure medications. For this reason, immunomodulatory therapies have been explored in an attempt to reduce inflammatory activity within the affected hemisphere. Bien and Schramm's review of treatments for Rasmussen encephalitis showed that corticosteroids, intravenous immunoglobulin, and other immunosuppressive drugs might temporarily reduce seizures in some patients.[7] However, the benefits of these treatments are often limited, and they might not provide long-term seizure control. Fauser et al. mentioned While immunotherapy can slow disease progression in some cases, many patients eventually develop epilepsy that doesn't respond to standard treatments, requiring additional therapies. The temporary improvement seen in this patient after receiving corticosteroids and intravenous immunoglobulin is consistent with previous reports of how patients respond to these treatments.

Surgical Treatment and Outcomes

Because seizures in Rasmussen encephalitis often don't respond to medication, surgery is often considered to control seizures over the long term. The most commonly performed procedure is functional hemispherotomy, which aims to disconnect the affected hemisphere from the rest of the brain while preserving essential brainstem and cerebellar structures. According to Bien and Schramm, hemispherotomy can significantly reduce seizure burden and may also help stabilize neurological decline in appropriately selected patients.[7] More recent evidence supports these observations. Trapp et al. described favorable outcomes following hemispherotomy in patients with Rasmussen encephalitis, even in some atypical presentations of the disease.[12] Early referral to specialized epilepsy centers is therefore recommended when progressive neurological deterioration and drug-resistant seizures are present.

Clinical Significance

The clinical presentation in this case closely resembles the patterns described in previous research. Progressive focal seizures, one-sided neurological deficits, and characteristic imaging findings are still key diagnostic indicators for Rasmussen encephalitis. Early recognition of these features is crucial, as a quick diagnosis allows doctors to start immunotherapy and consider surgical options before permanent neurological damage occurs.

DISCUSSION

Rasmussen encephalitis represents a distinctive neurological disorder characterized by chronic inflammation confined primarily to a single cerebral hemisphere. Since its original description in the mid-twentieth century, the condition has been recognized as an important cause of progressive focal epilepsy in pediatric populations.[1] In most patients, seizures represent the earliest manifestation of the disease. Varadkar et al. reported that focal motor seizures involving a single limb are frequently observed at the onset of Rasmussen encephalitis and may progressively increase in frequency over time.[3] A similar pattern was observed in our patient, whose illness began with focal clonic movements of the right upper limb before evolving into more complex seizure types. The gradual change in seizure semiology likely reflects progressive involvement of cortical networks within the affected hemisphere. Electroencephalographic findings in Rasmussen encephalitis typically demonstrate unilateral abnormalities that correspond to the inflamed hemisphere. Longaretti et al. The evolution of EEG patterns in affected children has been described, with a focus on how focal epileptiform discharges can gradually spread to larger areas of the affected hemisphere as the condition progresses.[4] The persistent epileptiform activity seen in the left hemisphere in this case aligns with these previous observations. Progressive neurological impairment

represents another hallmark of the disorder. Granata et al. The emergence of hemiparesis and cognitive decline, particularly when linked to focal epilepsy, warrants a high degree of suspicion for Rasmussen encephalitis.[5] In the present instance, the patient exhibited progressive right-sided weakness and a decline in academic achievement several months following the initial seizure activity, indicative of advancing neuronal damage localized to the left hemisphere. Magnetic resonance imaging (MRI) is essential for both confirming diagnoses and tracking how diseases develop. Early imaging can show subtle problems in the cortex. In contrast, later stages often show increasing atrophy of the brain's hemispheres and larger ventricles. Chiapparini and colleagues found that early MRI findings can be helpful for diagnosis, even before significant hemispheric atrophy is seen.[6] The imaging results in our patient, including one-sided cortical atrophy and enlarged ventricles, are consistent with these typical features. Recent neuroimaging investigations have further elucidated structural alterations extending beyond the visibly impacted hemisphere. Wagner and colleagues demonstrated that quantitative MRI methodologies can discern regional patterns of cortical volume reduction in individuals afflicted with Rasmussen encephalitis.[8] Likewise, David et al. observed subtle structural modifications within the contralateral hemisphere, implying that network-level transformations might transpire throughout the disease's advancement. These observations underscore the intricate neurobiological mechanisms that characterize the disorder. Current findings suggest that an immune-mediated process underlies neuronal damage in Rasmussen encephalitis. Histopathological examinations have demonstrated the infiltration of cytotoxic T lymphocytes into cortical tissue, accompanied by microglial activation and neuronal degeneration. Furthermore, Alvarez-Barón and colleagues observed autoantibodies and plasma cells within the affected brain tissue, thereby reinforcing the notion that immune mechanisms play a role in the disease's advancement.[10] Consequently, medical interventions have concentrated on mitigating inflammatory activity via immunotherapeutic approaches. Bien and Schramm reviewed therapeutic approaches and noted that treatments such as corticosteroids and intravenous immunoglobulin may reduce seizure frequency in some patients during the early stages of the disease.[7] Nevertheless, sustained seizure remission with medical therapy alone remains uncommon. In the present case, immunomodulatory treatment produced only transient improvement, which is consistent with previously reported outcomes. Fauser et al. It has been observed that while immunotherapy can slow disease progression in some patients, the majority ultimately experience medically intractable epilepsy, necessitating surgical intervention.[11] Given the progressive and frequently drug-resistant nature of seizures in Rasmussen encephalitis, surgical treatment continues to be the most efficacious therapeutic approach. Functional hemispherotomy seeks to sever the pathological neural networks that facilitate seizure spread, while safeguarding essential brainstem and cerebellar connections. Bien and Schramm documented significant seizure reduction subsequent to hemispherotomy in appropriately chosen patients.[7] More recently, Trapp et al. reported positive outcomes even in atypical presentations, thereby emphasizing the significance of early surgical evaluation.[12] The current case highlights the necessity of recognizing the distinctive clinical presentation of Rasmussen encephalitis. Progressive focal epilepsy, coupled with unilateral neurological deficits and hemispheric abnormalities evident on imaging, should prompt early consideration of this diagnosis. Early identification facilitates the prompt initiation of immunotherapy and referral for surgical assessment, both of which may impact long-term neurological outcomes.

Clinical Implications

This case underscores several practical considerations for clinicians treating pediatric and adolescent patients afflicted with progressive focal epilepsy. Initially, the occurrence of drug-resistant focal seizures, coupled with the development of unilateral neurological deficits, should prompt early consideration of Rasmussen encephalitis. Early identification is critical because the inflammatory phase of the condition may exhibit a partial response to immunomodulatory treatments. Furthermore, neuroimaging and electroencephalographic findings are indispensable for determining unilateral hemispheric involvement and directing the diagnostic process. Third, a multidisciplinary evaluation, incorporating neurologists, neuroradiologists, and epilepsy surgeons, is essential for optimal management. Referring patients to specialized epilepsy centers early allows for prompt evaluations regarding surgical options. This includes functional hemispherotomy, which remains the most effective method for long-term seizure control in advanced cases. **Limitations** This report is subject to specific constraints that warrant recognition. Given its nature as a single-case observation, the results are not broadly applicable to the entire population of individuals afflicted with Rasmussen encephalitis. Moreover, the inclusion of comprehensive longitudinal neuroimaging and electrophysiological data was precluded by institutional policies governing the dissemination of patient imaging records. At the time this manuscript was prepared, there was also limited information on the long-term results after surgery. Despite these limitations, this case study contributes to existing research by describing the clinical progress and diagnostic considerations related to Rasmussen encephalitis in adolescents.

Future Perspectives

Further research is needed to better understand the immune system's role in Rasmussen encephalitis and to find biomarkers that could allow for earlier diagnosis. Advancements in neuroimaging and molecular immunology could help clarify the disease processes that cause inflammation in one side of the brain and damage to nerve cells. Moreover, research into new immunotherapies and surgical methods could lead to better treatment results. Identifying patients who could benefit from immunomodulatory therapy or surgery is still a key area for future research.

CONCLUSION

Rasmussen encephalitis, though infrequent, represents a notable etiology of progressive, drug-resistant focal epilepsy in pediatric and adolescent populations. When focal seizures persist, along with worsening neurological problems on one side of the body and specific findings on brain scans, this diagnosis should be considered. Identifying promptly and using a multidisciplinary approach are crucial for improving treatment methods. Although immunotherapy might provide temporary symptom relief during the inflammatory phase, surgery remains the most effective way to achieve lasting seizure control in patients with difficult-to-treat conditions.

Author Contributions

Elavarasan G – Elavarasan G contributed to patient evaluation, clinical data collection, literature review, and preparation of the initial manuscript draft.

Viknesh Prabhu – Viknesh Prabhu contributed to clinical supervision, interpretation of neurological findings, and critical revision of the manuscript for important intellectual content.

Anis Preethi – Anis Preethi contributed to literature review, manuscript editing, and final approval of the submitted manuscript.

All authors reviewed the final manuscript and approved it for submission.

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Data Availability Statement

All data generated or analyzed during this study are included in this published article. Additional clinical information may be available from the corresponding author upon reasonable request, subject to institutional regulations regarding patient confidentiality.

Ethics Statement

This case report is based on a retrospective review of hospital records. Institutional ethics approval was not required for a single anonymized case. Written consent could not be obtained because the case occurred a long time ago and the patient could not be contacted. All information is anonymized, and images are not included due to lack of consent.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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