International Journal of Biomedicine 15(3) (2025) 590-593
http://dx.doi.org/10.21103/Article15(3)_CR1

CASE REPORT

INTERNATIONAL JOURNAL OF BIOMEDICINE

Pediatric Tumefactive Multiple Sclerosis Case Report and Literature Review: A Saudi Experience

Muhannad Alanazi[1*], Raed AlRuwaili[2]

[1]*Department of Internal Medicine, Division of Radiology, College of Medicine, Jouf University, Sakaka, Saudi Arabia*
[2]*Department of Internal Medicine, College of Medicine, Northern Border University, Arar, Saudi Arabia*

Abstract

Tumefactive demyelinating lesions (TDLs) are rare, mass-like lesions that present a significant diagnostic challenge, often mimicking brain tumors on magnetic resonance imaging (MRI). This case report describes a 9-year-old male who presented with progressive neurological symptoms, including persistent headaches, ataxia, and dysarthria. MRI findings raised concerns for both demyelinating and neoplastic processes, but a biopsy confirmed the diagnosis of tumefactive multiple sclerosis (TMS). The patient was successfully treated with high-dose corticosteroids, resulting in marked clinical improvement. This case emphasizes the importance of differentiating TDLs from neoplasms, particularly in pediatric patients, and highlights the role of biopsy and advanced imaging techniques in achieving an accurate diagnosis. Long-term follow-up with disease-modifying therapies is crucial to prevent relapse and progression.(**International Journal of Biomedicine. 2025;15(3):590-593.**)

Keywords: tumefactive demyelinating lesions • multiple sclerosis • corticosteroid therapy • brain tumor

For citation: Alanazi M, Raed AlRuwaili R. Pediatric Tumefactive Multiple Sclerosis Case Report and Literatures Review: A Saudi Experience. International Journal of Biomedicine. 2025;15(3):590-593. doi:10.21103/Article15(3)_CR1

Abbreviations

CNS, central nervous system; **DWI**, diffusion-weighted imaging; **FLAIR**, fluid-attenuated inversion recovery; **MS**, multiple sclerosis; **PWI**, perfusion-weighted imaging; **PLEX**, plasma exchange; **RRMS**, relapsing-remitting multiple sclerosis; **TDLs**, tumefactive demyelinating lesions; **TMS**, tumefactive multiple sclerosis.

Introduction

Tumefactive demyelinating lesions (TDLs) are a distinct and diagnostically challenging variant of demyelinating diseases within the multiple sclerosis (MS) spectrum. Tumefactive demyelinating lesions typically present as large, mass-like lesions that mimic neoplasms on magnetic resonance imaging (MRI) due to their size, ring enhancement, and associated edema.[1,2] These lesions are relatively uncommon, with an estimated prevalence of 1–3 per 1,000 MS patients. Still, they pose significant diagnostic challenges due to their resemblance to brain tumors such as gliomas and central nervous system (CNS) lymphomas.[3,4]

Tumefactive demyelinating lesions are often mistaken for tumors because of their radiological appearance and mass effect, making it essential to differentiate them from neoplasms to avoid inappropriate treatments.[5] Although more common in adults, pediatric cases of TDLs are particularly rare, with limited literature available on their clinical presentation and management.[1]

This case report aims to provide insights into the diagnostic process, treatment, and follow-up of a child with tumefactive multiple sclerosis.

***Corresponding author**: Muhannad Faleh Alanazi, Department of Internal Medicine, Division of Radiology, College of Medicine, Jouf University, Sakaka, Saudi Arabia. E-mail: mfra642@hotmail.com*

Advanced imaging techniques, such as diffusion-weighted imaging (DWI) and perfusion-weighted imaging (PWI), have been increasingly employed to distinguish TDLs from neoplasms. Yet, biopsy remains the gold standard for definitive diagnosis.[6] Treatment typically involves high-dose corticosteroids, and in cases refractory to corticosteroids, immunosuppressive therapies such as plasma exchange (PLEX) or rituximab may be considered.[7,8]

This case report presents a 9-year-old male diagnosed with a TDL, highlighting the clinical and radiological complexities involved in distinguishing it from neoplastic lesions and discussing the role of biopsy and tailored therapy in ensuring a favorable outcome.

Case Presentation

A 9-year-old male with no significant medical history presented to the neurology outpatient clinic with a two-month history of progressively worsening neurological symptoms. The patient's symptoms included persistent headaches, ataxia, and dysarthria. His parents reported that the headaches had increased in intensity over the past few weeks, becoming debilitating. There was no history of trauma, infection, or systemic illness. His family history was negative for neurological or autoimmune diseases, including multiple sclerosis or hereditary conditions.

Clinical Findings and Investigations

On neurological examination, the patient exhibited: 1) Ataxia: A wide-based, unsteady gait consistent with cerebellar dysfunction, 2) Dysarthria: Speech was slow and slurred, indicating impaired control of speech muscles, 3) Cranial Nerves: The cranial nerve examination was normal, with no evidence of optic neuritis, diplopia, or facial asymmetry, 4) Motor and Sensory Systems: Muscle strength was normal in all four limbs, and no sensory deficits were noted, and 5) Reflexes: Deep tendon reflexes were brisk but symmetrical, with no clonus or abnormal plantar responses. No signs of meningeal irritation were observed. The initial blood workup, including a complete blood count, metabolic panel, and inflammatory markers (C-reactive protein, erythrocyte sedimentation rate), was within normal limits.

Neuroimaging was pursued due to the progressive nature of the patient's symptoms and the absence of systemic signs of infection or other causes. Magnetic resonance imaging (MRI) of the brain revealed two large intra-axial lesions in the left cerebral hemisphere, primarily affecting the white matter. T2-weighted imaging (T2WI) showed that the lesions are hyperintense, suggesting the presence of edema or demyelination. Fluid-attenuated inversion recovery (FLAIR) imaging revealed that the lesions exhibit partial central suppression, indicative of active inflammation and demyelination. Gadolinium-enhanced T1-weighted imaging showed that faint, incomplete marginal enhancement was observed, a pattern characteristic of demyelinating processes where there is a partial breakdown of the blood-brain barrier. Diffusion-weighted imaging (DWI) revealed that the lesions exhibit areas of mild diffusion restriction, which can suggest tumefactive demyelination or, less likely, a neoplastic process. As a mass effect, the lesions caused a mild rightward shift of the midline structures, contributing to the patient's headaches and increased intracranial pressure (Figure 1).

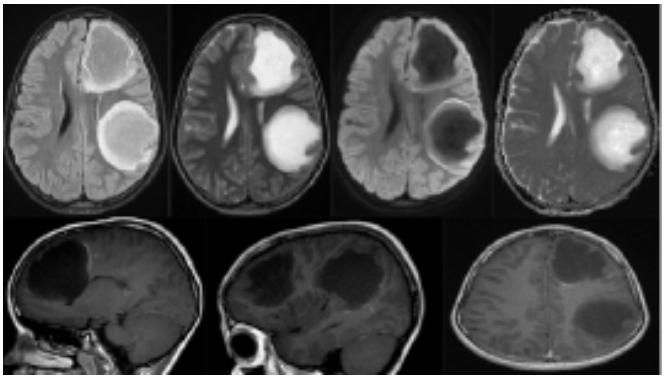

Figure 1. *A 9-year-old boy presented with headache, ataxia, and dysarthria for 2 months. Two large intra-axial, mildly expansile mass-like abnormalities centered within the left cerebral hemisphere white matter regions, with relative preservation of the overlying cortex. Imaging: T2WI hyperintensity with partial central FLAIR suppression, faint incomplete marginal enhancement, and marginal curvilinear areas of mild diffusion restriction causing mild rightward midline shift, mild effacement of left lateral ventricle, and left hemispheric sulcal effacement. The degree of mass effect is disproportionate to the lesion's size. No optic nerves or spinal cord lesions. The conclusive diagnosis is tumefactive demyelination lesions.*

Differential Diagnosis

Given the patient's clinical presentation and imaging findings, the differential diagnosis included: 1) Tumefactive Demyelinating Lesions (TDLs): These are large demyelinating plaques often mistaken for neoplasms due to their size and mass effect, 2) Pediatric Low-Grade Gliomas: Gliomas are more common in children but typically show more robust and homogeneous enhancement on imaging, and 3) Primary CNS Lymphoma: Although rare in children, lymphoma can present with ring-enhancing lesions, but these lesions tend to have more pronounced diffusion restriction. Given the uncertainty of the imaging findings and the potential for serious outcomes, a stereotactic biopsy of the larger lesion was performed to establish a definitive diagnosis.

Histopathological Findings

Histopathological analysis confirmed extensive demyelination with prominent loss of myelin and relative preservation of axons. Perivascular lymphocytic infiltration was observed, consistent with an inflammatory demyelinating process. There was no evidence of neoplastic cells or infection, ruling out both neoplastic and infectious etiologies. The final pathology report confirmed the diagnosis of a tumefactive demyelinating lesion consistent with tumefactive multiple sclerosis.

Treatment and Clinical Course

Following the confirmed diagnosis of TDL, the patient was treated with high-dose intravenous methylprednisolone (1,000 mg/day) for five days. This was followed by a tapering

course of oral corticosteroids over the next several weeks. The patient showed significant clinical improvement, with a marked reduction in headache severity and gradual resolution of ataxia and dysarthria.

The patient was discharged with a plan for close neurological follow-up and regular MRI scans to monitor for lesion progression or the formation of new lesions. Long-term management will likely include disease-modifying therapies to prevent future relapses, and the family was counseled on the importance of recognizing early signs of relapse.

Discussion

The exact pathophysiology of TDLs remains under investigation, though they are generally considered part of the MS spectrum. Studies have demonstrated a shared underlying autoimmune mechanism between TDLs and other demyelinating disorders, such as RRMS and neuromyelitis optica spectrum disorder (NMOSD).[2,9] Demyelination in TDLs is accompanied by perivascular lymphocytic infiltration and axonal preservation, as seen in this case. This suggests that the immune system selectively targets myelin sheaths without extensive neuronal damage, a hallmark of inflammatory demyelinating diseases.[8] There is growing evidence that environmental factors, including viral infections such as Epstein-Barr virus (EBV), and genetic predisposition may contribute to the development of TDLs. The association of TDLs with certain human leukocyte antigen (HLA) class II alleles, such as HLA-DRB1*15, supports the role of genetic susceptibility in the pathogenesis of these lesions.[10,11]

Tumefactive demyelinating lesions are a rare but important consideration in pediatric patients with mass-like brain lesions. The radiological appearance of TDLs, particularly their large size, ring enhancement, and mass effect, often leads to diagnostic confusion with neoplastic processes such as gliomas or CNS lymphomas.[4,6] This case highlights the importance of a thorough diagnostic workup, including advanced imaging techniques and, when necessary, histopathological confirmation through biopsy.

While advanced MRI techniques such as DWI and perfusion-weighted imaging (PWI) can help differentiate TDLs from tumors, the overlap in imaging characteristics often necessitates a biopsy for definitive diagnosis. In this case, the biopsy findings of demyelination and lymphocytic infiltration confirmed the diagnosis of a tumefactive demyelinating lesion, effectively ruling out malignancy and guiding appropriate treatment.[2,12-14]

Tumefactive demyelinating lesions are thought to be part of the MS spectrum, with their pathophysiology involving acute inflammatory demyelination. The presence of perivascular lymphocytic infiltration on histopathology suggests an autoimmune process similar to that seen in relapsing-remitting MS (RRMS).[9] Corticosteroid therapy is the mainstay of treatment for TDLs, with most patients responding well to high-dose steroids, as seen in this case.[8] For patients who do not respond to corticosteroids, additional immunosuppressive therapies such as plasma exchange (PLEX) or rituximab may be necessary.[7]

The prognosis for patients with TDLs varies, with many experiencing a monophasic course and complete resolution of symptoms following treatment. However, some patients may go on to develop relapsing-remitting multiple sclerosis (RRMS) or experience recurrent episodes of tumefactive lesions.[15,16] Studies suggest that up to 30% of patients with tumefactive demyelinating lesions may progress to RRMS, emphasizing the importance of long-term follow-up and early intervention with disease-modifying therapies.[5,15] In this case, the patient responded well to corticosteroid therapy, with resolution of his acute neurological symptoms. However, continued monitoring and preventive measures, such as immunomodulatory treatments, will be crucial to prevent future relapses and long-term neurological decline.

While conventional MRI remains the primary diagnostic tool for detecting CNS demyelination, additional advanced imaging modalities can be used to further differentiate TDLs from other lesions. Dynamic susceptibility contrast (DSC) MRI can help differentiate demyelinating lesions from high-grade gliomas by evaluating the relative cerebral blood volume (rCBV). Tumefactive demyelinating lesions typically have lower rCBV compared to high-grade tumors.[6] Similarly, diffusion tensor imaging (DTI) can provide information about white matter tract disruption, which is more pronounced in tumors than in demyelinating lesions.[14,17]

Magnetic resonance spectroscopy is another useful tool for distinguishing TDLs from neoplasms by analyzing the biochemical composition of the lesion. A lower choline/creatine ratio is more commonly seen in demyelinating lesions, whereas a higher ratio is characteristic of neoplastic processes. [12-14,18] Despite these advancements, histopathological examination remains the gold standard for confirming the diagnosis, particularly when the imaging findings are ambiguous.

Corticosteroids remain the first-line treatment for TDLs, as they reduce inflammation and accelerate lesion resolution. This patient's favorable response to intravenous methylprednisolone aligns with the literature, where corticosteroid therapy has been shown to improve clinical outcomes in most cases.[13-16] However, in cases where corticosteroids are insufficient, plasma exchange (PLEX) and other immunosuppressive therapies, such as rituximab or cyclophosphamide, have been successfully used.[7,19] Using disease-modifying therapies, such as interferon-beta or glatiramer acetate, may also reduce the likelihood of future relapses.[12-16]

The long-term prognosis for TDLs is generally favorable, especially in patients with a monophasic disease course. However, in patients who transition to RRMS or experience recurrent tumefactive episodes, the risk of accumulating disability increases.[5,14] This highlights the importance of early diagnosis, appropriate treatment, and long-term follow-up to monitor potential relapses and initiate preventive therapies when necessary.[14,15]

Conclusion

Our case demonstrates the diagnostic challenges of differentiating tumefactive demyelinating lesions from brain tumors, especially in pediatric patients. Advanced imaging

techniques and histopathological confirmation are essential for accurate diagnosis. Early and aggressive treatment with corticosteroids can lead to significant clinical improvement, as seen in this case. Long-term follow-up with regular MRI scans and the use of disease-modifying therapies will be crucial in preventing future relapses and maintaining the patient's neurological health.

Ethical Considerations

The patient's legal guardians gave informed consent for publishing the case report, including images and other clinical information, except individual details identifying the patient.

Competing Interests

The authors declare that they have no competing interests.

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