Journal of Medicine, Physiology and Biophysics
ISSN 2422-8427 An International Peer-reviewed Journal
Vol.75, 2025

Evaluation of Magnetic Resonance Imaging Characteristics in Pediatric Acute Transverse Myelitis Presenting with Paraparesis: A Hospital-Based Cross-Sectional Study

Babar Ali[2*], Ayesha Momin[1], Muhammad Waseem Tariq[1], Muhammad Nadeem[2], Muhammad Naeem[2], Zonaina Nadeem[2]

The School of Allied Health Sciences UCHS and CH Lahore, Punjab, Pakistan[1]

The University of Lahore; Lahore, Punjab, Pakistan[2]

[*]E-mail of Corresponding Author: babarali0741@gmail.com

Abstract

Acute transverse myelitis is basically inflammation of one or more segments of the spinal cord, commonly in children. The purpose of the study was to determine the abnormalities in children with acute transverse myelitis detected on MRI. A cross-sectional study was conducted at the Diagnostic Radiology Department of the Children's Hospital and Institute of Child Health, Lahore, Punjab, Pakistan. Seventy pediatric patients aged 0-15 years, diagnosed with acute transverse myelitis, underwent MRI of the spinal cord. Data were collected using convenient sampling following ethical committee approval. MRI findings, including T2 hyperintensity, spinal cord swelling, and post-contrast enhancement, were recorded and analyzed using descriptive statistics and chi-square tests to assess associations with age and lesion location. Among the 70 children studied, 68 (97.1%) exhibited T2 hyperintensity, 63 (90%) showed spinal cord swelling, and 16 (22.9%) displayed post-contrast enhancement. The most common levels of abnormality were identified in the thoracic region (50%), followed by the cervical region (42.9%) and the lumbar region (7.1%). Magnetic resonance imaging abnormalities were more common in pediatric patients of acute transverse myelitis presenting with paraparesis. This study demonstrates that MRI abnormalities, particularly T2 hyperintensity, spinal cord swelling, and post-contrast enhancement, are commonly observed in pediatric patients with acute transverse myelitis presenting with paraparesis. The thoracic region emerged as the most frequently affected area, with children aged 6-10 years representing the majority of cases.

Keywords: Acute transverse myelitis, Magnetic resonance imaging, Paraparesis T2 hyper intensity, Post contrast enhancement.

DOI: 10.7176/JMPB/75-02
Publication date: January 31st 2025

1. Introduction

Acute transverse myelitis (ATM) is an uncommon and a type of advanced autoimmune illness that causes spinal cord de-myelination and is marked by sensory, motor, and autonomic impairment. According to active epidemiological investigations in Western countries, the number of cases in kids under the age threshold of 16 is 1 till 9 for each million annually. Prior to the instigation of the condition, the patients had no previous record of neurological abnormalities. Lower back pain is common at first, which is trailed by para- or tetra paresis, issues with a level of sensory loss, and sphincter malfunction between hours or days can occur at initial stages (Celik H et al. 2021). ATM can appear as a solitary syndrome, known as sporadic ATM. However, ATM can be related to additional (multifaceted and/or multiphasic) central nervous system acquired demyelinating syndrome (ADS), which includes acute dispersed encephalomyelitis (ADEM), numerous scleroses, also known as MS and optic nerve inflammation range disorders (NMOSD) (Helfferich J et al. 2021). ATM affects roughly 0.2 out of one hundred thousand kids per year (Holroyd KB et al 2018). In a child with myelitis, an MRI of the spinal cord and brain provides vital signs to the fundamental diagnosis. Lesions in ATM often include the white matter of the spinal cord or both gray and white matter, but lesions in AFM are more limited to the gray matter, specifically the anterior horn of vertebrae. Although elevated protein level and level of lymphocytic pleocytosis are the most prevalent results in children with ATM or AFM, protein in cerebrospinal fluid (CSF) and there is normal level of white blood cell counts seen in this disease, there is a significant proportion of them (Elrick MJ et al. 2019).

In a child with myelitis, a brain MRI and MRI of spinal cord provides vital evidences to the fundamental finding (Messacar K et al. 2019). Lesions in ATM often include spinal cords (white matter) or it can be both in gray and in white matter, but lesions in AFM are more limited to the gray matter, specifically the anterior horn of vertebrae (Dubey D et al. 2019). However, this preference for gray matter has been observed in various causes, most notably in MOG antibody-associated diseases (Tantsis EM et al. 2019).

Acute transverse myelitis, or ATM, is an immune-mediated, inflamed outbreak on the spinal cord that accounts for around 20 percent of all pediatric ADS cases. ATM could be a monophasic demyelinating illness, the first sign of a persistent, is degenerating and de-myelinating condition, or the neurological appearance of a systemic autoimmune illness. Mono-phasic and degenerating demyelinating illnesses is advanced significantly, notably with the finding of anti-bodies that mediate these illnesses. The discovery of autoantibodies against AQP4 also known as aquaporin-4 or brain protein that are oligodendrocyte protein (MOG) in the proper clinical context aids in the diagnosis of optic neuromyelitis spectrum diseases (NMOSD) and MOG-associated degenerative sicknesses. Despite the fact that this growing diagnostic classification has inferences for enhancing long-standing therapy plan, the present supports of treatment of acute ATM. Although this emerging diagnostic categorization has consequences for optimizing long-term therapy planning, high-dose intravenously corticosteroids, intravenous immunoglobulins (IVIg), and or exchange of plasma (PLEX) remain the current supports of treatment of acute. While ATM has a modest male high proportion overall, a female majority is observed in individuals at higher risk for the development of multiple sclerosis (MS). The average age of presentation ranges from 8 to 11 years. ATM neurologic symptoms often begin with back pain and it progress to sensory and motor impairments. Autonomic dysfunction of bowel and dysfunction of bladder malfunction is observed. Neurological signs might appear suddenly (within hours) or gradually. Weakness of ATM is usually bilateral, while incomplete cord myelitis can cause asymmetric neurologic symptoms. The tone of the muscles and reflexes may initially be reduced; yet, upper motor neuron symptoms (e.g., hyper-areflexia, enhanced tone) that developed extra prominent. As the medical experience progresses, this will become clear. Numbness, paresthesia's, and hyperesthesia's are common examples of sensory abnormalities. In certain cases, the spinal level can be visible, albeit deficits can be patchy based on the location of the lesion in the spinal. Female sex and the occurrence of accompanying lesion of brain as well as to the acute spinal cord lesion are markers of a recurring demyelinating illness at the moment of ATM. ATM accompanied by prolonged feeling sick, vomiting, or hiccup suggests postrema involvement and is supplementary predictive of myelitis (Manguinao M et al. 2019). While no FDA-approved treatments for ATM are currently available, the inflammatory of acute onslaught of ATM is routinely treated with intravenous high dose at first-line or corticosteroid IV can be used as a first line of medication. Pediatric IV methylprednisolone (IVMP) dose is between twenty and thirty mg per kg per day (up to one g per day) for 3 to 5 days. For affected who have recovered but have had an unfinished retrieval after high-dose of IVMP treatment, an oral prednisone taper commencing at between one and two mg per kg per day and tapering over the period of 2 till 4 weeks is an option. As an adjuvant treatment, immunoglobulin given by intravenous infusion (IVIg) is sometimes employed to corticosteroid or as a second-line choice. IV Ig is given at a dose of 2 grams per kg over a period of between two and five days (Zalewski NL et al. 2018). PLEX which stands for plasma exchange, when steroids are prohibited and patients that don't respond to corticosteroid therapy, or the affected person has life-threatening impairments is commonly employed. PLEX characteristically comprises of 5 to 7 trades that occur every other day for 10 to 14 days (Manguinao M et al. 2019).

The typical MRI appearance in acute transverse myelitis is a central T2 hyper intense spinal cord lesion extending over more than two segments, involving more than two-thirds of the cross-sectional area of cord 11-14, with variable pattern of enhancement and no diffusion restriction. This study aims to provide a detailed analysis of MRI characteristics in children diagnosed with acute transverse myelitis presenting with paraparesis. By identifying and describing the most common imaging findings, including T2 hyperintensity, cord swelling, and specific enhancement patterns, this research seeks to improve early diagnosis and treatment strategies. Enhanced understanding of these MRI indicators is crucial in guiding clinical decisions and optimizing patient outcomes in pediatric ATM cases.

2. Materials and Methods

This study was designed to determine MRI findings of acute transverse myelitis in children presenting with paraparesis. It was a cross sectional study and Convenient sampling was used in this study. The sample size was 70. Written informed consent was taken from all the participants. All information and data collection were kept confidential. Ethical approval for this study (Ethical Committee Ref No: 1390 / SAHS) was provided by the School of Allied Health Science UCHS & CH Lahore on January 15th, 2024.

Inclusion criteria

- The patients from 0 years to 15 years of age
- Male and female both genders included

Exclusion criteria

- Ruling out other vascular, metabolic and systemic causes of spinal cord inflammation
- Patients of syringohydromyelia

Data was collected from the Department of Radiology Children hospital, and the Institute of Child Health Lahore, Punjab, Pakistan from March 2024 to July 2024. A Performa was designed to gather the data for this study. Basically, a Performa was a list of queries that were filled by researchers and considered to provide the required information. The researchers filled this semi-structured, close ended Performa at hospital. At first, the Performa was provided to the ethical approval committee to ensure that the questions were appropriate according to the objective of the study. Any kind of inappropriate or perplexing questions were eliminated from the Performa.

All the data was entered in SPSS version 16 and then analyzed for statistically significant outcomes. Descriptive analysis was used to describe the basic features of the data and the Chi square test was used to check the association of different categories of variables. Descriptive analysis was used to describe the basic features of the data in the study. It provided simple summary about the sample and the measures.

3. Results

Over the study period, 70 pediatric patients with confirmed diagnosis of acute transverse myelitis had examination in Diagnostic Radiology Department of the Children's Hospital and institute of Child Health Lahore. Out of 70 pediatric patients, 42 (60%) were females and 28 (40%) were males as shown in table 1.

Table 1: Gender of the patients

Gender	Percentage
Female	60%
Male	40%

The table 2 shows that out of 70 pediatric patients, 20 (28.6%) were of age group 0-5 years, 31 (44.3%) were of age group 6-10 years and 19 (27.1%) were of age group 11-15 years.

Table 2: Age of the patients

Age group of the patient	**Percentage**
0-5 years	28.6%
6-10 years	44.3%
11-15 years	27.1%

Children with diagnosed acute transverse myelitis presented with different clinical features. The most common clinical features were progressive motor deficit in lower limb, numbness in limbs, tingling sensations in limbs, loss of bladder function and loss of bowel function as shown in table 3.

Table 3: Percentages of clinical features in patients

Clinical features	Yes	No
Fever	42.9%	57.1%
Muscle spasm	32.9%	67.1%
Pain in both lower limbs	31.1%	62.9%
Back pain	20%	80%
Numbness in limbs	95.7%	4.3%
Tingling sensation in limbs	94.3%	5.7%
Loss of bowel function	57.2%	42.8%
Loss of bladder function	64.3%	35.7%
Decreased deep tendon reflexes	48.6%	51.4%
Sensory loss	42.8%	57.2%
Progressive motor deficit in lower limb	100%	0%

The table 4 demonstrates that out of 70 pediatric patients, 68 (97.1%) had shown T2 hyper intensity on MR image, 63 (90%) patients shown cord swelling and 16 (22.9%) had shown post contrast enhancement. The level of abnormality was different among these pediatric patients.

Table 4: Percentages of MRI findings in different age groups

MRI Findings	Yes	No
T2 hyper intensity	97.1%	2.9%
Cord swelling	90%	10%
Enhancement	22.9%	77.1%

The level of abnormality was different among these pediatric patients. Out of 70 patients, 30 (42.9%) had abnormality at cervical region, 35 (50%) patients had abnormality detected at thoracic region and 5 (7.1%) had abnormality at lumbar region as shown in table 5.

Table 5: Percentages of various levels of abnormality in different age groups

Level of abnormality	Percentages
Cervical region	42.9%
Thoracic region	50%
Lumbar region	5%

Table 6: Association of MRI findings with the age of the patient

MRI Findings	X^2 (P value)
T2 hyper intensity	0.905 (0.636)
Enhancement	7.932 (0.019)

There was no association between MRI findings of acute transverse myelitis in children presenting with paraparesis and the age of patients except in post contrast enhancement with the p-value of 0.019 (Table 6).

4. Discussion

MRI is fundamentally important and has become increasingly relevant in the evaluation and management of children having acute transverse myelitis. In the evaluation of acute transverse myelitis, MRI is imaging modality of choice. MRI has emerged as a versatile tool in children with acute transverse myelitis. Our study reveals that 68 patients showed T2 hyper intensity on MR image. The most common MRI findings were T2 hyper intensity and cord swelling. 16 patients during our study showed post contrast enhancement. There were variable enhancement patterns i.e., none, diffuse, patchy and peripheral.

Ester G et al., 2020 conducted a retrospective study was performed on 23 children (11 males and 12 females), between 0 to 15 years of age, who were diagnosed with acute transverse myelitis. 21(91%) showed T2 hyper intensity. In 17 (74%) patients, abnormality was in thoracic region of the cord. The most common clinical features observed were progressive motor deficit in lower limb, numbness in limbs and loss of proper bowel functioning. The results of the study were very close to our study (Ganelin-Cohen E et al. 2020). A similar study was published in American journal of neuroradiology in July by Bulut et al., 2019. In that study 77 patients of acute transverse myelitis were evaluated retrospectively. Out of 77 patients, 68(88.3%) were presented with cord swelling and 38 (49%) showed post contrast enhancement on MR imaging. They explained cord swelling, T2 hyper intensity and post contrast enhancement as early MR imaging predictors of relapse in patients with acute transverse myelitis of unknown etiology (Bulut EL 2019).

Suther R et al., 2016 conducted a concordant retrospective study was performed in North India on 36 patients of acute transverse myelitis presenting with paraparesis. MRI showed cord swelling in 27(75%) children and thoracic region was most affected i.e., in 18(50%) patients. These results were quite similar to our study (Suthar R et al. 2013). Defrense P et al., 2003 conducted a study was performed on 24 children, aged between 2-14 years, diagnosed with acute transverse myelitis. Out of 24 patients, 21(87.5%) showed T2 hyper intensity and 17 (70%) showed cord swelling on MR image. The results of all these studies are similar to the outcome of our study. T2 hyper intensity and cord swelling is the most common MRI finding seen in pediatric patients of acute transverse myelitis (Defresne P et al. 2013).

Espinosa G et al., 2015 conducted study according to our study around 97% patients with acute transverse myelitis showed T2 hyper intensity and 90% showed cord swelling, these results are quite similar to the study performed on 22 patients diagnosed with acute transverse myelitis. All patients showed T2 hyper intensity on MR image. Most common region affected i.e., in 19(86.4%) patients, was cervical to mid thoracic spinal region (Espinosa G et al. 2015). Allper G et al., 2011 conducted a study was performed on 21 children diagnosed with acute transverse myelitis, aged between 5 to 12 years. All patients i.e., 21(100%) showed cord T2 hyper intensity on MR image. Cord swelling was seen in 19(90%). Only 7(33.3%) patients showed post contrast enhancement (Alper G et al. 2011).

This study emphasises the importance of MRI in detecting and evaluating acute transverse myelitis (ATM) in paediatric patients, especially those who show with paraparesis. The results confirm the high prevalence of T2 hyperintensity, spinal cord oedema, and considerable involvement of the thoracic region. This work emphasises the importance of early imaging in guiding quick and focused therapies by linking these MRI findings to clinical manifestations. Future study that includes long-term clinical outcomes and bigger, more diverse populations may increase our understanding of ATM's prognosis and guide better treatment techniques.

This study had several limitations. First, the short duration of the study limited the sample size to 70 pediatric patients, which may affect the generalizability of the findings to larger populations. Additionally, the use of

convenient sampling may introduce selection bias. The study's focus on a single institution could also limit the applicability of the results across different healthcare settings. Future research with larger, more diverse populations and extended study periods would help validate and expand upon these findings.

5. Conclusion

Magnetic resonance imaging abnormalities were more common in pediatric patients of acute transverse myelitis presenting with paraparesis. This study demonstrates that MRI abnormalities, particularly T2 hyperintensity, spinal cord swelling, and post-contrast enhancement, are commonly observed in pediatric patients with acute transverse myelitis presenting with paraparesis. The thoracic region emerged as the most frequently affected area, with children aged 6-10 years representing the majority of cases. Recognizing these specific MRI patterns, including spinal cord swelling, can aid clinicians in the timely diagnosis and management of ATM, potentially improving outcomes for affected children.

References

Celik, H., Aksoy, E., Oztoprak, U., Ceylan, N., Aksoy, A., Yazici, M. U., Azapagasi, E., Eksioglu, A. S., Yücel, H., Senel, S., & Yuksel, D. (2021). Longitudinally extensive transverse myelitis in childhood: Clinical features, treatment approaches, and long-term neurological outcomes. Clinical Neurology and Neurosurgery, 207, 106764. https://doi.org/10.1016/j.clineuro.2021.106764

Helfferich, J., Bruijstens, A. L., Wong, Y. Y., van Pelt, E. D., Boon, M., Neuteboom, R. F., Bakker, D. P., Braun, K. P., van Dijk, K. G., Eikelenboom, M. J., & Engelen, M. (2021). Prognostic factors for relapse and outcome in pediatric acute transverse myelitis. Brain and Development, 43(5), 626–636. https://doi.org/10.1016/j.braindev.2020.12.019

Holroyd, K. B., Aziz, F., Szolics, M., Alsaadi, T., Levy, M., & Schiess, N. (2018). Prevalence and characteristics of transverse myelitis and neuromyelitis optica spectrum disorders in the United Arab Emirates: A multicenter, retrospective study. Clinical and Experimental Neuroimmunology, 9(3), 155–161. https://doi.org/10.1111/cen3.12458

Elrick, M. J., Gordon-Lipkin, E., Crawford, T. O., Van Haren, K., Messacar, K., Thornton, N., Dee, E., Voskertchian, A., Nance, J. R., Muñoz, L. S., & Gorman, M. P. (2019). Clinical subpopulations in a sample of North American children diagnosed with acute flaccid myelitis, 2012–2016. JAMA Pediatrics, 173(2), 134–139. https://doi.org/10.1001/jamapediatrics.2018.4890

Messacar, K., & Tyler, K. L. (2019). Enterovirus D68–associated acute flaccid myelitis: Rising to the clinical and research challenges. JAMA, 321(9), 831–832. https://doi.org/10.1001/jama.2019.1016

Dubey, D., Pittock, S. J., Krecke, K. N., Morris, P. P., Sechi, E., Zalewski, N. L., Weinshenker, B. G., Shosha, E., Lucchinetti, C. F., Fryer, J. P., & Lopez-Chiriboga, A. S. (2019). Clinical, radiologic, and prognostic features of myelitis associated with myelin oligodendrocyte glycoprotein autoantibody. JAMA Neurology, 76(3), 301–309. https://doi.org/10.1001/jamaneurol.2018.4053

Tantsis, E. M., Prelog, K., Alper, G., Benson, L., Gorman, M., Lim, M., Mohammad, S. S., Ramanathan, S., Brilot, F., & Dale, R. C., Paediatric Myelitis MRI Study Group. (2019). Magnetic resonance imaging in enterovirus-71, myelin oligodendrocyte glycoprotein antibody, aquaporin-4 antibody, and multiple sclerosis-associated myelitis in children. Developmental Medicine & Child Neurology, 61(9), 1108–1116. https://doi.org/10.1111/dmcn.14114

Manguinao, M., Krysko, K. M., Maddike, S., Rutatangwa, A., Francisco, C., Hart, J., Chong, J., Graves, J. S., & Waubant, E. (2019). A retrospective cohort study of plasma exchange in central nervous system demyelinating events in children. Multiple Sclerosis and Related Disorders, 35, 50–54. https://doi.org/10.1016/j.msard.2019.07.004

Zalewski, N. L., & Flanagan, E. P. (2018). Autoimmune and paraneoplastic myelopathies. In Seminars in Neurology, 38(3), 278–289. https://doi.org/10.1055/s-0038-1660856

Manguinao, M., Krysko, K. M., Maddike, S., Rutatangwa, A., Francisco, C., Hart, J., Chong, J., Graves, J. S., & Waubant, E. (2019). A retrospective cohort study of plasma exchange in central nervous system demyelinating events in children. Multiple Sclerosis and Related Disorders, 35, 50–54. https://doi.org/10.1016/j.msard.2019.07.004

Ganelin-Cohen, E., Konen, O., Nevo, Y., Cohen, R., Halevy, A., Shuper, A., & Aharoni, S. (2020). Prognostic parameters of acute transverse myelitis in children. Journal of Child Neurology, 35(14), 999–1003. https://doi.org/10.1177/0883073820947512

Bulut, E. L., Shoemaker, T., Karakaya, J. A., Ray, D. M., Mealy, M. A., Levy, M., & Izbudak, I. (2019). MRI predictors of recurrence and outcome after acute transverse myelitis of unidentified etiology. American Journal of Neuroradiology, 40(8), 1427–1432. https://doi.org/10.3174/ajnr.A6121

Suthar, R., Sankhyan, N., Sahu, J. K., Khandelwal, N. K., Singhi, S., & Singhi, P. (2016). Acute transverse myelitis in childhood: A single-center experience from North India. European Journal of Pediatric Neurology, 20(3), 352–360. https://doi.org/10.1016/j.ejpn.2016.01.013

Defresne, P., Hollenberg, H., Husson, B., Tabarki, B., Landrieu, P., Huault, G., Tardieu, M., & Sébire, G. (2003). Acute transverse myelitis in children: Clinical course and prognostic factors. Journal of Child Neurology, 18(6), 401–406. https://doi.org/10.1177/08830738030180060601

Espinosa, G., & Cervera, R. (2015). Current treatment of antiphospholipid syndrome: Lights and shadows. Nature Reviews Rheumatology, 11(10), 586–596. https://doi.org/10.1038/nrrheum.2015.88

Alper, G., Petropoulou, K. A., Fitz, C. R., & Kim, Y. (2011). Idiopathic acute transverse myelitis in children: An analysis and discussion of MRI findings. Multiple Sclerosis Journal, 17(1), 74–80. https://doi.org/10.1177/1352458510381393