

Acute Leukoencephalopathy with Diffusion Restriction in a pre-school child – A Case Report

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ABSTRACT:

Background: Acute leukoencephalopathy with restricted diffusion (ALERD) is a clinical-radiological diagnosis characterized by severe encephalopathy and seizures with restricted diffusion in the bilateral cerebral parenchyma on Magnetic Resonance Imaging.

Clinical description: A 1-year-6-month-old female child admitted with complaints of fever and loose motion for 3 days, followed by repeated episodes of generalized tonic-clonic seizure. On examination, the child was unconscious and afebrile, GCS -12/15. Planter B/L non-responding, deep tendon reflex was brisk. Other systemic examinations were within normal limits.

Management & outcome: Complete blood count showed the presence of leukocytosis with neutrophilic predominance. In cerebrospinal fluid examination, 10-12 cells are predominantly lymphocytic. Other biochemical parameters are within normal limits. MRI brain showed diffusion restriction of bilateral cortical and subcortical frontal, parietal, and temporal regions, along with corpus callosum and ventral thalami, suggestive of diffused ALERD. The patient was treated with intravenous methyl prednisolone 30 mg/kg, which was given for 3 days, followed by oral prednisolone along with symptomatic treatment.

Conclusion: This case highlights the importance of early recognition of ALERD, and proper immunotherapy, which provides better outcomes.

Keywords: *Febrile encephalopathy, Immunotherapy, Leukoencephalopathy, Magnetic resonance induction, Seizure*

INTRODUCTION:

Acute encephalopathy is a severe neurological dysfunction characterized by the sudden onset of altered level of consciousness, seizure, and various neurological deficits. It predominantly affects the younger children due to viral infections, leading to severe morbidity and mortality. So early diagnosis is crucial for effective treatment and prognosis. Common causes of acute encephalopathy are febrile encephalopathy (viral meningoencephalitis, bacterial meningitis), systemic disorders (dysselectrolytes, sepsis), hypoxic ischemic attack, toxins, trauma, and stroke [1]. Recently, a new

term, acute encephalopathy with restricted diffusion (ALERD), has been established, especially in East Asia [2].

It is characterized by seizures with fever, an altered level of consciousness for 1-4 weeks, and an MRI (magnetic resonance imaging) shows areas of restricted diffusion. Based on MRI findings, two types of ALERD are described- diffuse ALERD and central sparing ALERD [3]. Diffuse ALERD is associated with severe clinical features with rapid deterioration, and central ALERD is manifested with mild clinical features with a biphasic course. We are presenting a case of diffuse ALERD in a toddler after taking parental consent, with febrile

encephalopathy, seizure, and diffuse restriction in the MRI brain.

Clinical Description:

1-year-6-month female, Hindu child, born of a non-consanguineous marriage, admitted in emergency with complaint of high-grade fever along with loose motion for 3 days, and repeated 3 episodes of GTCS lasting for 20-25 minutes in 24 hours. Loose motion was of an acute onset, watery, 3-4 episodes, without blood staining. In the past history, no history of similar illness, vomiting, or seizure. The child was delivered by normal vaginal delivery at the hospital and cried immediately after birth. No history of NICU admission. In developmental history, the child had attained all milestones at the proper age. In family history, no history of a similar type of illness or premature death. On examination at the time of admission, the child was unconscious, afebrile, and the GCS was 11/15. In vitals, respiratory rate 36/minute, heart rate 128/minute. In a head-to-toe examination, no facial dysmorphism or neurocutaneous marker. In anthropometry, weight-8 kg, length-79 cm, HC- 48 cm. In systemic examination, CNS- unconscious, Antero fontal closed, pupil B/L –normal, reacting to light. Planter B/L not responding, deep tendon reflex was brisk. Respiratory and CVS were within normal limits. In the abdomen, there is no hepatosplenomegaly. Based on the above

description, acute meningoencephalitis, febrile seizure, HUS, and electrolyte abnormality were made as differential diagnoses.

Management & outcome:

In complete blood count (Table 1) Hb 11 gm/dl, total leucocyte count 17060/uL, Neutrophil 70.8%, lymphocyte 21.3%.CRP 6 mg/l (0-6 mg/l) and ESR was 32 mm at 1 hour (normal range 0-20). Peripheral blood smear was within normal limits. In electrolytes, serum Na-143.2 mmol/l, serum K-3.38 mmol/l, Calcium -9.33 mg/dl. Another kidney function, liver function test, and random blood sugar were normal. In cerebrospinal fluid examination, color was clear, total cell count was 10-12 cells/cmm, mostly lymphocytes (95%), sugar 83.9 mg/dl, and proteins 19.2 mg/dl. The blood culture report was sterile. Other viral markers like HIV, hepatitis B, and C were negative. In the EEG, focal spikes were seen mostly over the left centro-parietal and temporal cortices. In the MRI, the brain showed areas of diffusion restriction noted in bilateral deep and subcortical white matter, predominantly involving bilateral frontal, parietal, and right temporal lobes, corpus callosum, and bilateral ventral thalami; diffuse acute leukoencephalopathy with flow restriction diffusion. CSF for anti-NMDA was negative to rule out autoimmune encephalitis.

Table: 1. Laboratory and Radiological Investigations

Test name	Laboratory value	Normal value
Total Leucocyte count	17060	4000-11000/uL
Hemoglobin	11	12-16 gm/dl
Neutrophil	70.8%	40-75%
Lymphocyte	21.3%	20-45%
C reactive protein	6	0-6 mg/l
Erythrocyte sedimentation rate	32	0-20 mm in first hour
Sodium/Potassium/Calcium	143.2/3.38/9.33	Sodium-135-145 mEq/L, Potassium-3.5-5 mEq/L, Calcium-9-11 mg/dl
Kidney function Serum urea Serum creatinine	Urea-22, creatinine-0.8	Urea 15-40 mg/dl Creatinine 0.6-1.2 mg/dl
Cerebro spinal fluid examination	Cells-10-12 lymphocytic(95%), protien-19.2, sugar-83.9	Protien-15-45 mg/dl, cells 0-5 u/L, only lymphocyte, glucose 2/3 of blood sugar
Electroencephalogram (EEG)	focal spikes, seen mostly over left Centro-parietal and temporal cortices	
Magnetic Resonance Imaging (MRI) Brain	showed area of diffusion restriction are noted in bilateral deep and subcortical white matter predominantly involving bilateral frontal, parietal and right temporal lobe, corpus callosum and bilateral ventral thalami ; diffuse acute leukoencephalopathy with flow restriction diffusion	

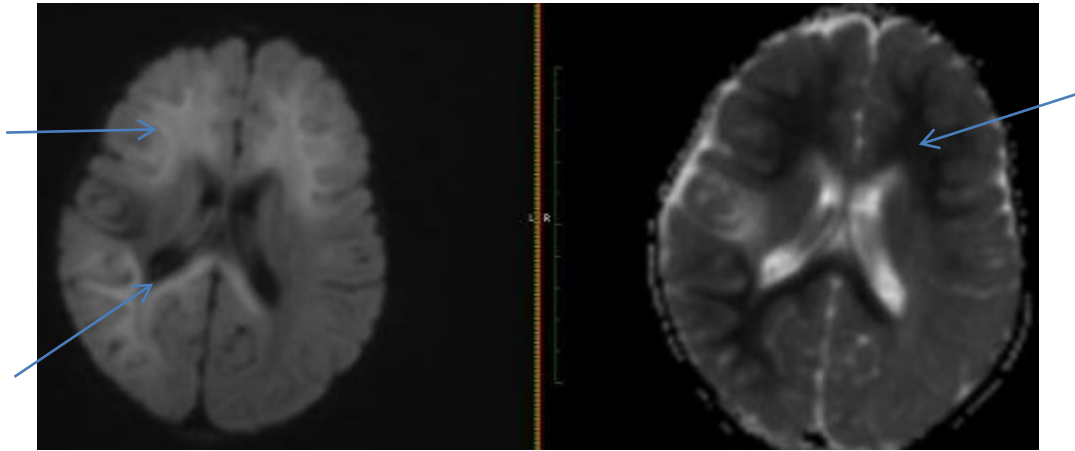


Figure 1 (DWI) showing areas of diffusion restriction are noted in bilateral subcortical white matter mainly frontal, parietal right temporal corpus callosum and B/L ventral thalamic & reversal on apparent diffusion coefficient A2 (ADC) map.

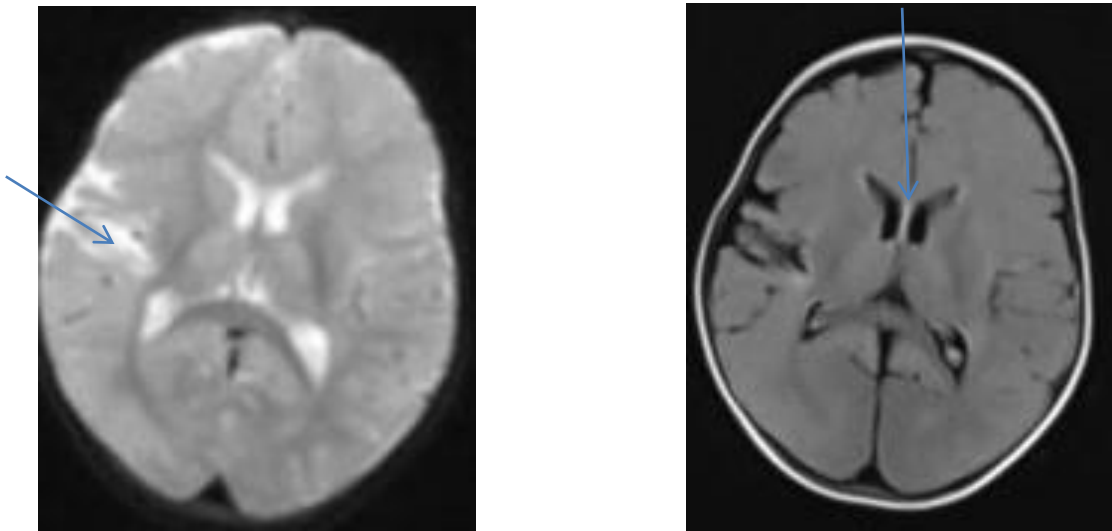


Figure 2, B1(T2) B2(FLAIR) showing hyper intensity in B/L perisylvian gyri, ventral thalamic and medial temporal lobe.

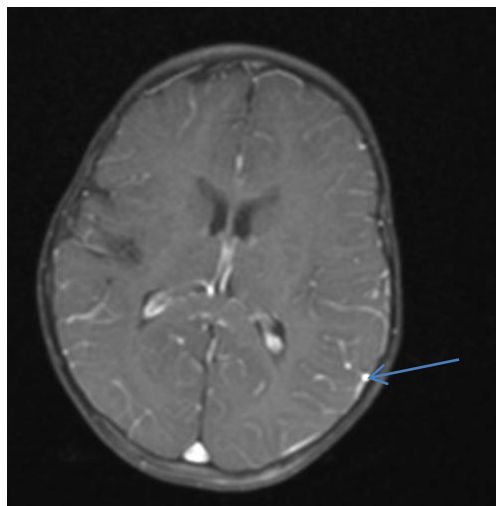


Figure 3 (T1) normal finding and no significant contrast enhancement seen.

Treatment:

Child was treated in PICU, with oxygen, Inj ceftriaxone, Inj amikacin, Inj acyclovir, and anti-epileptic Inj phenytoin, along with intravenous fluid. Initially. The seizure was difficult to control, so midazolam infusion was given. On the sixth day of admission, MRI brain showed diffusion restriction of bilateral cortical and subcortical frontoparietal-temporal regions along with corpus callosum and ventral thalami, suggestive of diffused ALERD (Figure 1) with normal findings in T1, and no significant contrast enhancement seen (Figure 3), which rules out the meningitis. After that, methyl prednisolone 30 mg/kg was given for 3 days, followed by 2mg/kg/day and tapered over the next 2 weeks. After 7 days, the patient was shifted to the ward after seizure control, regaining full consciousness. At the time of discharge, the child was conscious, without any focal neurological deficit. In follow up for 2 month child was neurologically normal and gaining weight.

DISCUSSION:

ALERD is a clinico-radiological condition characterized by an acute onset of fever, seizure, and altered level of consciousness along with restricted areas of diffusion in cortical and subcortical regions on MRI [4]. This case was presented with a monophasic course, possibly infective etiology with diffuse ALERD, with complete recovery. This case study showed some differences from the Japanese cohort, which showed diffuse ALERD with a monophasic course had a poor outcome. Infectious ALERD occurs after infections, while toxic ALERD occurs due to exposure to toxins, drug abuse, and cranial irradiation [4]. The proposed pathogenesis of ALERD is hypercytokinemia, evidenced by raised levels of IL-6, IL8, IL10 and tumor necrosis factor in serum and cerebrospinal fluid, which lead to excitotoxic damage and neuronal death. In some cases, they are associated with hemophagocytic syndrome [5]. Several causative or triggering agents like human herpes virus-6, adenovirus,

rotavirus, influenza, mycoplasma pneumoniae, enterovirus, and E. coli 0157:H7 were associated with ALERD as shown in case series from Nagoya University, Japan [4]. Streptococcal pneumoniae can also be associated with bacterial septic encephalopathy manifested as ALERD [6]. In my case report, because of a lack of facilities and financial constraints, a complete viral panel was not done to determine the specific etiology workup.

In ALERD, an MRI brain done in the late stage of disease shows bright tree appearance on DWI that should be reversed on apparent diffusion coefficient maps, which is the characteristic of ALERD[8]. In this case, an MRI of the brain was done on the 9th day of disease, which showed characteristic of diffuse ALERD. When changes are marked or MRI is done at a late stage, then signal changes may be seen on T2-weighted and FLAIR sequences (Figure 2). Use of Intravenous pulse steroids and IVIG after ruling out the neuroinfectious has a better outcome [7]. In some case report use of N-methyl-D-aspartate (NMDA) receptor antagonist, dextromethorphan, apoptosis inhibitor, and cyclosporine has been mentioned in view of the proposed pathogenesis of ALERD, which is an excitotoxic injury with neuronal death [8]. The outcome of ALERD from the previous study showed low mortality (<5%), with outcomes ranging from normal to severe mental retardation, paralysis, and epilepsy [9].

CONCLUSION:

ALERD is emerging as one of the important causes of acute encephalopathy in Pediatrics. MRI on DWI showing restricted diffusion in subcortical white matter is a characteristic feature that should be done after 3-4 days of illness. This case report showed that early diagnosis and prompt treatment with immunotherapy, along with supportive care, provide better outcomes without any morbidity even in diffuse ALERD.

- ALERD is emerging as a one of the important cause of acute encephalopathy in pediatrics with protracted outcome.
- Diagnosis of ALERD ,based on MRI brain done in late stage of disease shows bright tree appearance on DWI that should be revert on apparent diffusion coefficient maps.
- High index of suspicion, early diagnosis and prompt immunotherapy along with supportive care, provides better outcome without any morbidity even in diffuse ALERD.

Ethical Approval:

Informed consent taken of patient and parent.

Contribution of each Author:

Sudesh Kumar: establishing clinical diagnosis, planning investigations, management and follow-up.

Anmol Singh Gill: establishing clinical diagnosis, planning investigations, management and follow-up.

Randeep Gill: establishing clinical diagnosis, planning investigations, management and manuscript writing.

Support: None

Conflict of interest: Nil

REFERENCES:

1. Kamate M. Acute leukoencephalopathy with restricted diffusion. Indian J Crit Care Med. 2018;22(07):519–523. doi: 10.4103/ijccm.IJCCM_139_18. [DOI] [PMC free article] [PubMed] [Google Scholar]
2. Ranjan R S, Arya G, Yadav V K. Acute encephalopathy with biphasic seizures and late reduced diffusion (central sparing type)-MRI and MR spectroscopy findings. Indian J Radiol Imaging. 2019;29(04):426–430. doi: 10.4103/ijri.IJRI_235_19. [DOI] [PMC free article] [PubMed] [Google Scholar]
3. Kamate M. Acute leukoencephalopathy with restricted diffusion Indian J Crit Care Med. 2018;22:519–23
4. Ito Y, Natsume J, Kidokoro H, Ishihara N, Azuma Y, Tsuji T, et al. Seizure characteristics of epilepsy in childhood after acute encephalopathy with biphasic seizures and late reduced diffusion. Epilepsia. 2015;56:1286-93.[CrossRef] [PubMed] [Google Scholar]
5. Tadokoro R, Okumura A, Nakazawa T et al. Acute encephalopathy with biphasic seizures and late reduced diffusion associated with hemophagocytic syndrome. Brain Dev. 2010;32(06):477–481. doi: 10.1016/j.braindev.2009.05.007. [DOI] [PubMed] [Google Scholar]
6. Yamaguchi H, Tanaka T, Maruyama A, Nagase H. Septic encephalopathy characterized by acute encephalopathy with biphasic seizures and late reduced diffusion and early nonconvulsive status epilepticus Case Rep Neurol Med. 2016;2016:7528238
7. Okumura A, Kidokoro H, Tsuji T, Suzuki M, Kubota T, Kato T, et al Differences of clinical manifestations according to the patterns of brain lesions in acute encephalopathy with reduced diffusion in the bilateral hemispheres AJNR Am J Neuroradiol.;30:825–30
8. Matsuo M, Maeda T, Ono N, Sugihara S, Kobayashi I, Koga D, et al Efficacy of dextromethorphan and cyclosporine a for acute encephalopathy Pediatr Neurol. 2013;48:200–5
9. Yamaguchi, H. · Nishiyama, M. · Tokumoto, S. ...Detailed characteristics of acute encephalopathy with biphasic seizures and late reduced diffusion: 18-year data of a single-center consecutive cohort J. Neurol. Sci. 2020; 411:116684