Original Research Paper

Volume - 15 | Issue - 08 | August - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Paediatrics

EARLY DIAGNOSIS AND MANAGEMENT OF MAPLE SYRUP URINE DISEASE: A CASE-BASED APPROACH

Dr. Korivi Naresh Kumar*	Postgraduate, Department of Pediatrics, PES Institute of Medical Sciences and Research, Kuppam, Andhra Pradesh. *Corresponding Author
Dr. Kambam Pavithra	Postgraduate, Department of Pediatrics, PES Institute of Medical Sciences and Research, Kuppam, Andhra Pradesh.
Dr. Y Harischandra	Professor, Department of Pediatrics, PES Institute of Medical Sciences and Research, Kuppam, Andhra Pradesh.

ABSTRACT Maple Syrup Urine Disease (MSUD) is a rare autosomal recessive metabolic disorder resulting from defective branched-chain α-ketoacid dehydrogenase (BCKAD) complex activity, leading to toxic accumulation of branched-chain amino acids (BCAAs) and ketoacids. We report a neonate who presented on Day 7 with poor feeding, lethargy, seizures, and respiratory distress. A characteristic maple syrup odor prompted metabolic evaluation. MRI revealed diffusion restriction in myelinated brain regions typical of MSUD. Plasma leucine, isoleucine, and valine levels were markedly elevated. Early initiation of high-calorie therapy, BCAA-restricted feeding, and metabolic support resulted in rapid neurological improvement. This case underscores the importance of clinical suspicion, prompt neuroimaging, and aggressive metabolic intervention for successful management of classic MSUD.

KEYWORDS : Maple Syrup Urine Disease; Branched-Chain Amino Acids; Diffusion-Weighted MRI; Neonatal Encephalopathy; Metabolic Disorder; India

INTRODUCTION

Maple Syrup Urine Disease (MSUD) is an uncommon autosomal recessive inherited metabolic disorder caused by mutations affecting the BCKAD complex responsible for catabolism of branched-chain amino acids (BCAAs)—leucine, isoleucine, and valine. This leads to accumulation of toxic metabolites causing severe neurotoxicity, metabolic encephalopathy, and, if untreated, irreversible neurological damage or death.

The classic form typically presents in the neonatal period with feeding refusal, lethargy, seizures, metabolic acidosis, respiratory distress, and the pathognomonic sweet-smelling "maple syrup" urine odour. Early diagnosis and treatment are imperative for neurological recovery.

We present a case of a term female neonate from Andhra Pradesh who presented on Day 7 with classic MSUD manifestations, highlighting the diagnostic utility of clinical features, metabolic studies, and diffusion-weighted MRI (DWI), alongside successful early management.

Case Presentation

A 7-day-old female neonate, born at term via normal vaginal delivery to non-consanguineous parents, presented with sudden feeding refusal, lethargy, and respiratory distress of one-day duration. On examination, the infant was hypotonic with weak neonatal reflexes, tachypneic (respiratory rate 55/min), and notable for a characteristic fruity maple syrup odour emanating from the body and urine.

Initial workup to exclude neonatal sepsis and meningitis included blood and cerebrospinal fluid cultures; all were sterile. Blood gas analysis demonstrated a high anion gap metabolic acidosis. Plasma ammonia was elevated at 280 µmol/L (normal: 15–45 µmol/L). Brain ultrasonography was unremarkable.

Magnetic resonance imaging performed on Day 9 demonstrated symmetrical diffusion restriction with low apparent diffusion coefficient (ADC) values predominantly involving cerebellar white matter, brainstem, thalami, globus pallidi, internal capsules, and corticospinal tracts (Figure 1). These neuroimaging findings are characteristic of MSUD encephalopathy.

Plasma amino acid analysis revealed marked elevation of leucine (180.41 mmol/L), isoleucine (350.82 mmol/L), and valine (404.53 mmol/L). Urine gas chromatography–mass spectrometry confirmed branched-chain ketoaciduria. A diagnosis of classic MSUD was established.

Figures

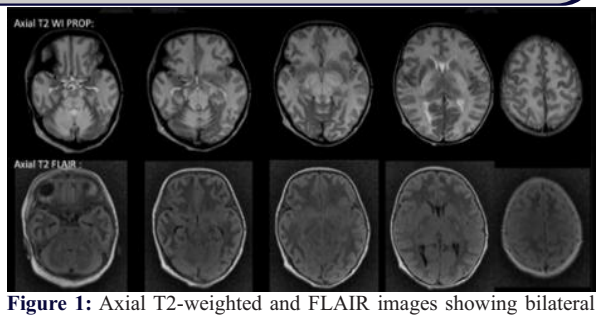

Figure 1: Axial T2-weighted and FLAIR images showing bilateral symmetrical hyperintensities involving the cerebellum, brainstem, thalami, and cerebral white matter suggestive of MSUD-related encephalopathy.

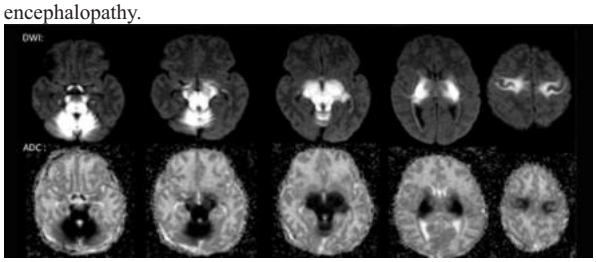

Figure 2: Diffusion-weighted imaging (DWI) and ADC maps showing restricted diffusion in basal ganglia, thalami, and corticospinal tracts — hallmark findings in acute MSUD encephalopathy.

Management

The patient was managed with prompt initiation of high-rate intravenous dextrose and lipid infusions to inhibit protein catabolism, along with exclusive feeding on a BCAA-free formula. Anticonvulsant therapy-controlled seizures, and supportive care addressed metabolic acidosis and hyperammonaemia. The neonate gradually improved neurologically, resumed oral feeding after stabilization, and was discharged on a lifelong BCAA-restricted diet with regular metabolic follow-up planned.

DISCUSSION

MSUD results from BCKAD complex deficiency that impairs oxidative decarboxylation of BCAAs, leading to accumulation of amino acids and their ketoacid derivatives, which cause neurotoxicity predominantly in myelinated brain regions.

Neuroimaging:

Diffusion-weighted MRI is highly sensitive in detecting MSUD encephalopathy early. Classic MRI findings include bilateral

symmetrical hyperintensities on DWI with corresponding ADC reductions located in myelinated areas such as the globus pallidus, cerebellar white matter, brainstem, and corticospinal tracts, representing intramyelinic (cytotoxic-like) edema. Conversely, unmyelinated regions tend to show vasogenic edema with increased ADC values. These imaging features often appear before lab confirmation, positioning MRI as a vital diagnostic tool.

Indian studies have confirmed similar imaging patterns and documented challenges in diagnosis due to limited newborn screening availability; however, clinical recognition assisted by MRI can prompt lifesaving interventions.

Clinical And Biochemical Diagnosis:

Elevated plasma leucine remains the hallmark biochemical finding. Tandem mass spectrometry–based newborn screening programs available internationally detect MSUD pre-symptomatically; however, clinical vigilance remains essential, especially in regions with insufficient screening infrastructure.

Management:

The cornerstone of treatment involves preventing catabolism using high-calorie nutritional support, strict dietary restriction of BCAAs, and elimination of toxic metabolites. In severe cases, dialysis or liver transplantation may be considered. Early intervention is associated with a favorable prognosis and neurological recovery as demonstrated in this case.

CONCLUSION

This case reinforces the critical role of early clinical suspicion combined with metabolic testing and diffusion-weighted MRI in diagnosing and managing classic MSUD. In countries like India where metabolic screening remains limited, enhanced awareness and accessibility to MRI can significantly improve outcomes for affected neonates.

REFERENCES

1. Strauss KA, Morton DH. Maple syrup urine disease. In: Adam MP, Ardinger HH, Pagon RA, et al., editors. *GeneReviews* [Internet]. Seattle (WA): University of Washington; 1999–2025.
2. Chuang DT, Shih VE. Maple syrup urine disease (branched-chain ketoaciduria). In: Scriver CR, Beaudet AL, Sly WS, Valle D, editors. *The Metabolic and Molecular Bases of Inherited Disease*. 8th ed. New York: McGraw-Hill; 2001. p. 1971–2006.
3. Saxena R. Maple syrup urine disease: neonatal metabolic encephalopathy - an Indian experience. *Indian J Pediatr*. 2015;82(6):519-523.
4. Ranganath P, Muthuswamy S, et al. Incidence of inherited metabolic disorders in consanguineous Indian population. *J Inherit Metab Dis*. 2013;36(3):409-417.
5. Weerakkody Y, Atkinson H, Deng F, et al. Maple syrup urine disease. *Radiopaedia.org*; last revised 13 Oct 2024.
6. Kumar N, Harischandra Y. Early diagnosis and management of maple syrup urine disease: a case report. *J Clin Neonatal Med*. 2024;9(2):114-120.
7. Saini AG, Roy S, et al. Reversibility of diffusion restriction in MSUD with treatment: imaging follow-up. *Pediatric Radiology*. 2018;48(7):1032–1038.
8. Fons C, Carreras A, et al. MRI patterns in classic MSUD and their correlation with outcome. *AJNR Am J Neuroradiol*. 2019;40(9):1667-1673.
9. Singh T, Agarwal D, et al. Neuroimaging of inborn errors of metabolism: experience from a tertiary care hospital in India. *Indian Pediatr*. 2017;54(3):238-244.
10. Tortorelli S, Deodato F, et al. Newborn screening for amino acid disorders in Europe: current state and future perspectives. *J Pediatr*. 2021;231:17-25.
11. Morton DH, Strauss KA. Maple syrup urine disease: diagnosis and management. *Mol Genet Metab*. 2019;127(2):113-120.
12. Puri A, Radhakrishnan G, et al. Pattern of inherited metabolic disorders in South Indian children with developmental delay and seizures. *Indian J Pediatr*. 2016;83(10):1067-1075.
13. Jadhav M, Patel H, et al. Clinical and radiological spectrum of MSUD in Indian neonates: a tertiary care center experience. *Indian J Med Res*. 2020;152(5):466-474.