Case Report

Prolonged hypoglycemia leading to irreversible hypoglycemic encephalopathy: A case report

A. Arunagiri[1]*, J. Balasubramanian[2], Aravind Gautham[3], Kannan[4]

[1]Senior Consultant General Medicine & Diabetologist, Kauvery Hospital, Tirunelveli, Tamil Nadu
[2]Chief Transplant & Interventional Nephrologist, Kauvery Hospital, Tirunelveli, Tamil Nadu
[3]Consultant Neurologist Stroke Interventional Neurology Specialist, Kauvery Hospital, Tirunelveli, Tamil Nadu
[4]Consultant Anesthesiologist & Critical Care, Kauvery Hospital, Tirunelveli, Tamil Nadu
*Correspondence

Abstract

Background: Hypoglycemia is a common metabolic emergency in diabetic patients; however, prolonged untreated hypoglycemia can result in irreversible neurological injury. We report the clinical course of a 59-year-old male with Type 2 Diabetes Mellitus who presented with delayed recognition of severe hypoglycemia leading to diffuse cerebral edema and hypoglycemic encephalopathy. Despite early correction of glucose and intensive neurocritical care management, the patient showed no meaningful neurological recovery. Serial neuroimaging demonstrated progression from metabolic brain injury to hypoxic-ischemic sequelae. This case highlights the importance of early recognition and prevention of prolonged hypoglycemia to avoid devastating neurological outcomes.

Key words: Hypoglycemia; Type 2 Diabetes Mellitus; Hypoxic-ischemic sequelae

Citation: A. Arunagiri, J. Balasubramanian, Aravind Gautham, Kannan. Prolonged hypoglycemia leading to irreversible hypoglycemic encephalopathy: A case report. Kauverian Med J. 2026;3(6):27-31.

Academic Editor: Dr. Venkita S. Suresh

ISSN: 2584-1572 (Online)

1. Introduction

Hypoglycemia remains one of the most frequent complications of diabetes therapy. While most hypoglycemic episodes are transient and reversible, prolonged neuroglycopenia may lead to permanent neuronal damage and hypoglycemic encephalopathy. Hypoglycemic brain injury often resembles hypoxic-ischemic encephalopathy both clinically and radiologically. Diffusion-weighted MRI plays a crucial role in early diagnosis and prognostication. We describe a case demonstrating the clinical and radiological evolution of prolonged hypoglycemia resulting in irreversible encephalopathy.

2. Case Presentation

A 59-year-old male with known Type 2 Diabetes Mellitus and hypothyroidism was found unresponsive at home. He was last seen normal approximately 36 hours prior to presentation. At an initial peripheral healthcare facility, capillary blood glucose was found to be 39 mg/dL. Intravenous dextrose was administered; however, there was no improvement in sensorium. The patient was subsequently referred to our tertiary care

center for further management. On admission, the patient was unconscious with a Glasgow Coma Scale score of E2V2M1. Vital parameters were stable. Pupils were equal and reactive. Myoclonic jerks were present over the face and right upper limb. Due to persistent coma and poor airway reflexes, he was intubated and mechanically ventilated.

CT Brain: On admission, it showed bilateral diffuse cerebral edema. No other significant abnormality.

MRI brain demonstrated diffuse cortical diffusion restriction with bilateral basal ganglia involvement and diffuse cerebral edema, suggestive of severe metabolic brain injury. No focal infarction or intracranial haemorrhage was identified. Repeat CT scan after 6 days of admission showed bilateral diffuse cerebral edema with ischemia/ infarction of subcortical whitematter and corpus callosum – probable sequelae of hypoxic ischemic insult (HIE)

EEG report: Intermittent polyspike and wave discharge noted.

No significant background slowing.

No EEG features of non-convulsive status epilepticus.

Posterior predominant alpha rhythm.

Abnormal record.

During the ICU course, the patient developed acute kidney injury, cardiac dysfunction, and hyperammonemia. He received comprehensive supportive management including mechanical ventilation, osmotherapy, anticonvulsants, antibiotic therapy, and metabolic stabilization. Despite correction of hypoglycemia and stabilization of systemic parameters, the patient did not show neurological improvement. Repeat CT brain revealed subcortical white matter ischemic changes and corpus callosum involvement, consistent with hypoxic-ischemic sequelae.

In the present case, the patient developed severe prolonged hypoglycemia leading to profound neurological impairment, with no meaningful neurological recovery despite correction of blood glucose levels and intensive supportive care. The neurological examination remained poor throughout the hospital stay, with a Glasgow Coma Scale of E4V1M1, consistent with a persistent vegetative state. Prolonged coma following hypoglycemia has been reported to be associated with poor neurological outcomes and high mortality, especially when the duration of hypoglycemia exceeds several hours.

The patient's prolonged ICU stay, and persistent coma resulted in prolonged mechanical ventilation, necessitating tracheostomy after repeated failed weaning attempts. Prolonged ventilatory support significantly increases the risk of ventilator-associated pneumonia (VAP), which is a major cause of morbidity and mortality in critically ill patients.

During the later course of hospitalization, the patient developed ventilator-associated pneumonia due to multidrug-resistant (MDR) Klebsiella species, which progressed to leucopenic septic shock requiring vasopressor support. Nosocomial infections with MDR organisms are increasingly reported in patients with prolonged ICU stays and mechanical ventilation and are associated with high mortality rates.

Additionally, the patient developed acute kidney injury (AKI) during the septic course, which later showed signs of improvement with supportive management. However, the

combined burden of severe hypoglycemic brain injury, persistent coma, MDR infection, and septic shock contributed to progressive clinical deterioration.

Despite aggressive management including mechanical ventilation, targeted antimicrobial therapy, vasopressor support, and intensive critical care, the patient ultimately succumbed to illness after 26 days of hospitalization.

This case highlights the devastating neurological consequences of prolonged hypoglycemia and the significant complications associated with prolonged ICU care, particularly ventilator-associated infections with multidrug-resistant organisms. Early recognition and rapid correction of hypoglycemia remain crucial in preventing irreversible neurological damage and improving clinical outcomes.

3. Discussion

Hypoglycemic encephalopathy is an uncommon but devastating complication of prolonged neuroglycopenia, characterized by diffuse neuronal injury resulting from inadequate cerebral glucose availability. The brain relies almost exclusively on glucose as its primary metabolic substrate; therefore, sustained hypoglycemia results in rapid energy failure, disruption of cellular ionic gradients, and subsequent neuronal death. The pathophysiology of hypoglycemic brain injury differs from classical hypoxic-ischemic encephalopathy, although both conditions may share overlapping radiological features. In hypoglycemia, neuronal injury is primarily mediated by excitotoxic mechanisms rather than oxygen deprivation. Experimental models have demonstrated that glucose depletion leads to excessive release of excitatory amino acids, particularly glutamate, resulting in intracellular calcium influx, oxidative stress, and cytotoxic edema. This cascade ultimately culminates in selective neuronal vulnerability, predominantly affecting metabolically active regions such as the cerebral cortex, hippocampus, and basal ganglia.

Neuroimaging plays a pivotal role in both diagnosis and prognostication. Diffusion-weighted MRI is particularly sensitive in detecting early hypoglycemic injury, often demonstrating bilateral cortical and deep gray matter diffusion restriction. The distribution of lesions has been shown to correlate with clinical outcomes. Diffuse cortical involvement, as observed in this case, is associated with poor neurological recovery and increased mortality. Additionally, involvement of the corpus callosum and subcortical white matter suggests severe and prolonged metabolic insult, often indicating irreversible injury. An important aspect highlighted by this case is the temporal evolution of hypoglycemic brain injury. Initial metabolic neuronal dysfunction may progress to structural hypoxic-ischemic changes if neuroglycopenia persists or secondary systemic complications occur. This progression is reflected radiologically by the transition from diffuse cytotoxic edema to established white matter ischemic injury. Such radiological evolution is infrequently documented and underscores the dynamic nature of metabolic brain injury. Delayed recognition of hypoglycemia remains a critical determinant of outcome. In diabetic patients, especially those with autonomic neuropathy or impaired hypoglycemia awareness, prolonged undetected hypoglycemia can occur. The estimated duration of untreated hypoglycemia in this patient was likely sufficient to produce irreversible neuronal injury prior to initiation of therapy. Even though prompt glucose correction was achieved at presentation, the therapeutic window for neuronal salvage had likely been exceeded.

Furthermore, systemic complications during the intensive care course, including acute kidney injury, cardiac dysfunction, and metabolic derangements, may have contributed to secondary cerebral injury. The interplay between primary neuroglycopenic damage

and secondary critical illness–related insults likely compounded the poor neurological outcome. Current literature suggests that prognostic indicators in hypoglycemic encephalopathy include duration of hypoglycemia, depth of coma, extent of MRI abnormalities, and persistence of neurological deficits following glucose correction. The presence of diffuse cortical diffusion restrictions, persistent coma beyond 72 hours, and radiological evidence of white matter involvement have been consistently associated with unfavorable outcomes. This case reinforces the need for early detection and prevention of hypoglycemia in diabetic patients. Continuous glucose monitoring, patient education, and individualized glycemic targets are essential preventive strategies. From a neurocritical care perspective, early neuroimaging and aggressive supportive management remain the mainstay of treatment; however, once diffuse neuronal injury is established, therapeutic options are largely supportive.

4. Conclusion

Prolonged untreated hypoglycemia can lead to devastating and irreversible neurological injury. Early recognition, prompt correction, and preventive diabetic education remain essential to avoid hypoglycemic encephalopathy.

5. Learning Points

- Prolonged hypoglycemia can cause irreversible brain injury.
- Diffuse MRI diffusion restrictions predict poor outcome.
- Hypoglycemic encephalopathy may evolve into hypoxic-ischemic injury.
- Prevention and early treatment are critical in diabetic patients.

References

[1] Auer RN. Hypoglycemic brain damage. Metab Brain Dis. 2004;19(3-4):169-175.

[2] Suh SW, Hamby AM, Swanson RA. Hypoglycemia, brain energetics, and hypoglycemic neuronal death. Glia. 2007;55(12):1280-1286.

[3] Kang EG, Jeon SJ, Choi SS, Song CJ, Yu IK. Diffusion MR imaging of hypoglycemic encephalopathy. AJNR Am J Neuroradiol. 2010;31(3):559-564.

[4] Hasegawa Y, Formato JE, Latour LL, et al. Severe transient hypoglycemia causes reversible change in brain diffusion-weighted MRI findings. Stroke. 1996;27(9):1648-1655.

[5] Johkura K, Nakae Y, Kudo Y, Yoshida TN, Kuroiwa Y. Early diffusion MR imaging findings and short-term outcome in comatose patients with hypoglycemia. AJNR Am J Neuroradiol. 2012;33(5):904-909.

[6] Fujioka M, Okuchi K, Hiramatsu KI, et al. Specific changes in human brain after hypoglycemic injury. Stroke. 1997;28(3):584-587.

[7] Witsch J, Neugebauer H, Flechsenhar J, et al. Hypoglycemic encephalopathy: a case series and literature review. J Neurol. 2012;259(10):2096-2105.

[8] Ikeda T, Takahashi T, Sato A, et al. Diffusion-weighted MRI findings in hypoglycemic encephalopathy. Neurology. 2001;57(5):933-935.

[9] Ma JH, Kim YJ, Yoo WJ, et al. MR imaging of hypoglycemic encephalopathy: lesion distribution and prognosis prediction. Neuroradiology. 2009;51(10):641-649.

[10] Cryer PE. Mechanisms of hypoglycemia-associated autonomic failure in diabetes. N Engl J Med. 2013;369(4):362-372.