Hyperbaric oxygen therapy for hypoglycaemic encephalopathy due to insulinoma: a case report

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Abstract
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Introduction: Hypoglycaemic encephalopathy is a potentially life-threatening condition which can present with seizures, altered mental status or focal neurologic deficits. Therapeutic options are limited and the overall prognosis is poor. Among previously reported cases, the maximum time for patients to recover consciousness after hypoglycaemic encephalopathy was 14 days. So far, no studies have reported that hyperbaric oxygen therapy (HBOT) can improve the consciousness disorder of hypoglycaemic encephalopathy.
Case report: We report a case of hypoglycaemic encephalopathy caused by insulinoma who had a refractory consciousness disorder for 90 days and whose recovery was temporally related to institution of HBOT, suggesting that HBOT is a possible treatment for hypoglycaemic encephalopathy.
Conclusions: Hyperbaric oxygen therapy can be considered in hypoglycaemic encephalopathy when the hypoglycaemia has been corrected but patients still have reduced consciousness.

Introduction

Hypoglycaemic encephalopathy (HE) manifests as one of the prominent clinical features of severe hypoglycaemia. HE can present with seizures, coma or focal neurologic deficits and frequently be mistaken as stroke or other neurologic disorders.[1] HE due to insulinoma is rare and difficult to diagnose and treat.

There is controversy around the role of hyperbaric oxygen treatment (HBOT) in neurological disorders, with some evidence of benefit in acute and chronic traumatic brain injury,[2] but to date these problems do not appear on the Undersea and Hyperbaric Medicine Society list of approved indications.[3] Whether HBOT can treat the consciousness disorder caused by hypoglycaemia or insulinoma has not been reported. We report a case of a 65-year-old woman with HE caused by insulinoma whose recovery was temporally related to institution of HBOT. We highlight the potential for misdiagnosis and missed diagnosis in HE, and identify a new potential treatment option for refractory consciousness disorder caused by hypoglycaemia or insulinoma.

Case report

Written informed consent for publication of the clinical details, laboratory tests and clinical images was obtained from the guardian of the patient.

A 65-year-old woman was admitted to the emergency department because of paroxysmal dizziness and episodic cognitive impairment for two years and coma for two days. She had no significant past medical history and family history. She was free from drug or alcohol abuse. Her episodic cognitive impairment resulted in occasionally arriving at the wrong place and failing to find her way home. Events lasted for a few hours, and occurred once or twice a month. During this period the patient had been admitted to the emergency room and the blood glucose was normal. She had been hospitalised in the department of neurology and diagnosed as transient ischemic attack (TIA).

Two days before the admission described here, the patient suddenly appeared unconscious and unresponsive. She was unconscious at home for two days and medical treatment was not sought. On the third day, she was admitted to the

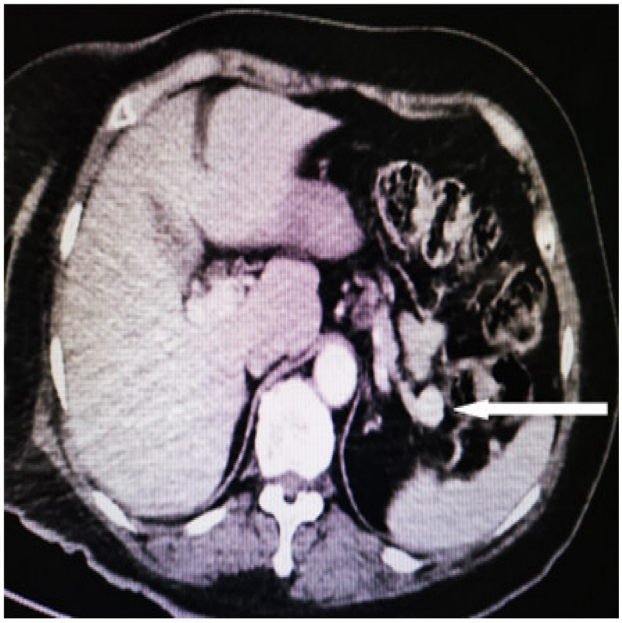
emergency room in a comatose state. Her blood glucose was undetectable (less than 1 mmol·L^{-1}) on arrival. Although hypoglycaemia was corrected after intravenous glucose injection, her consciousness did not recover. Laboratory serum tests demonstrated increased proinsulin, insulin and C peptide levels, implying inappropriate endogenous insulin production (Table 1). Pancreatic enhanced computed tomography was performed to confirm the diagnosis and location, and it revealed a mass in the tail of the pancreas (Figure 1). Combined with the patient's clinical manifestations, a diagnosis of insulinoma was finally made and surgical resection of tumor was performed. However, the patient's consciousness disorder did not improve after the operation with a Glasgow Coma Scale Score of 7 (E2V2M3).

Three months after the episode of coma, the patient was admitted to our department of hyperbaric oxygen medicine because of a refractory consciousness disorder unimproved over three months. The Glasgow Coma Scale Score was still 7 (E2V2M3), the same as previously. Brain magnetic resonance imaging (MRI) (Figure 2A) showed extensive bilateral lesions in the cerebral cortex, basal ganglia and periventricular areas. Electroencephalogram (EEG) showed many 10–40 uV and 3–7 c·s^{-1} δθ waves. She was diagnosed with HE and HBOT (253 kPa [2.5 atmospheres absolute], 60 min, once a day) was started. Surprisingly, after only three sessions the patient's consciousness was improved, showing a response to verbal stimuli and being able to speak inappropriate words. After 10 sessions the patient's cognitive function was further improved. She could open her eyes spontaneously and localise pain stimuli. After 30 sessions of HBOT, the patient's cognitive function was significantly improved. She could communicate in short sentences, eat by herself, stand and walk slowly with others' help (outcome scores are shown in Table 2). She tolerated HBOT well without any adverse effects. Re-examination of the brain MRI showed that the lesion area was smaller than that before HBOT (Figure 2B). Re-examination of the EEG showed that δθ waves were less than that before HBOT. The patient was satisfied with the treatment effect and discharged from the hospital. After half a year's follow-up, there was no significant change in patients' consciousness compared with that at discharge.

Table 1
Values of laboratory serum tests obtained during hypoglycaemic episode

Test	Value	Reference range
Blood glucose	< 1.0	4.1−5.9 (mmol·L^{-1})
Proinsulin	1750.40	30−180 (pg·mL^{-1})
Insulin	98.27	4.03−23.46 (mIU·L^{-1})
C peptide	3907.20	99.9–1242.1 (pmol·L^{-1})

Figure 1
Pancreatic enhanced computed tomography image outlining suspected pancreatic mass. Area in question is a 1.6 x 1.5cm mass in the tail of pancreas (highlighted by arrow)



Discussion

HE is a potentially life-threatening manifestation of hypoglycaemia, which can present with seizures, altered mental status or focal neurologic deficits.[1] HE due to insulinoma is rare and difficult to diagnose as it mimics a great variety of neurological conditions. In addition, as in an earlier presentation of this case, some patients' blood glucose levels have returned to normal when they arrive at hospital, which increases the difficulty of diagnosis and easily leads to missed diagnosis and misdiagnosis.[4] In this case, the patient suffered from dizziness and cognitive impairment repeatedly in the early stage of the disease, but her blood glucose level was normal in several visits to the hospital. So, the possibility of hypoglycaemia was missed, and she was diagnosed as TIA. Therefore, for patients with recurrent dizziness and cognitive impairment, the blood glucose should be measured repeatedly to avoid delay in diagnosis and treatment of insulinoma.

In the last episode of hypoglycaemia, the patient appeared unconscious, but her family thought it was still a TIA attack and observed her at home for two days without seeing a doctor, resulting in prolonged hypoglycaemia and severe brain damage. Even though the hypoglycaemia was corrected and the tumor was removed, the patient's consciousness disorder had not improved. Although the new definition of TIA does not take into account the duration of symptoms, symptoms of TIA generally do not exceed 24 hours, and most TIAs are considered to last less than 1 or 2 hours.[5] This suggests that it is necessary to carry out adequate education for the patient's family members, that is, if the patient's symptoms continue to be unrelieved, they should seek medical treatment as soon as possible.

Figure 2

Brain MRI images; (A) before HBOT, showing extensive bilateral lesions in the cerebral cortex, basal ganglia and periventricular areas; (B) after 30 HBOT sessions, the lesion area was substantially reduced

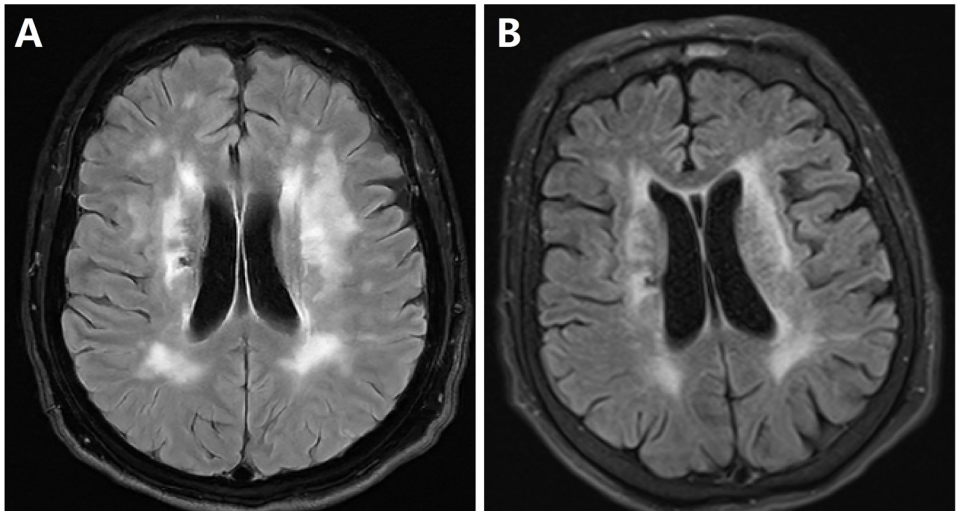


Table 2

Outcome scores; outcome was assessed using the Glasgow coma scale (GCS), coma recovery scale-revised (CRS-R) score, functional independence measure (FIM) and Barthel index (BI) before hyperbaric oxygen treatment (HBOT), after three sessions of HBOT, after 10 sessions of HBOT and after 30 sessions of HBOT

Parameter	Before HBOT	After 3 HBOT	After 10 HBOT	After 30 HBOT
GCS	E2V2M3	E3V3M4	E4V4M5	E4V5M6
CRS-R	1	4	9	15
FIM	18	18	24	55
BI	0	0	20	60

HBOT is considered to be safe and well-tolerated, and although there is controversy about efficacy in brain injury, there is some evidence for benefit following brain trauma and stroke. However, whether HBO can treat the consciousness disorder caused by hypoglycaemia / insulinoma has not been reported. In addition, it has been suggested that HBOT is unlikely to revert severe brain injury with major neuron loss and therefore should be considered mainly at the early stage of relevant disorders, when only minimal cognitive deficiency was detected.[2] Among previously reported cases, the maximum time for patients to recover consciousness after HE was 11 days,[6] 13.3 days[7] and 14 days[8] respectively. However, in this case, the patient's consciousness had been severely disturbed for 90 days, and improved after only three sessions of HBOT, suggesting that improvement of consciousness could occur even after 90 days after HE, and that HBOT is a potential treatment even if it is not given in the early stage of the disease. Thirty sessions of HBOT was associated with significant improvement of the patient's cognitive function, suggesting that for cognitive impairment caused by hypoglycaemia, if the patient's neurological function failed to meet expectations, HBOT should be continued for at least 30 sessions. However, no firm conclusions can be based on a case report and further observational reports in more patients are needed.

Conclusions

For patients presenting with recurrent episodic dizziness and cognitive impairment, blood glucose should be measured repeatedly to avoid delay in diagnosis and treatment of insulinoma. In patients who have suffered HE, HBOT can be considered when the hypoglycaemia has been corrected but patients still exhibit a consciousness disorder, even if it is not in the early stage of the disease.

References

1 Hasebe M, Shibue K, Honjo S, Hamasaki A. Hypoglycemic encephalopathy. QJM. 2022;115:478–9. doi: 10.1093/qjmed/hcac125. PMID: 35583317.

2 Marcinkowska AB, Mankowska ND, Kot J, Winklewski PJ. Impact of hyperbaric oxygen therapy on cognitive functions: a systematic review. Neuropsychol Rev. 2021;32:99–126. doi: 10.1007/s11065-021-09500-9. PMID: 33847854.

3 Huang ET, editor. Hyperbaric medicine indications manual. 15th ed. North Palm Beach (FL): Best Publishing Company; 2023.

4 Ferrer-García JC, González-Cruz VI, Navas-DeSolís S, Civera-Andrés M, Morillas-Ariño C, Merchante-Alfaro A, et al. Management of malignant insulinoma. Clin Transl Oncol. 2013;15:725–31. doi: 10.1007/s12094-012-0996-7. PMID: 23460559.

5 Easton JD, Saver JL, Albers GW, Alberts MJ, Chaturvedi S, Feldmann E, et al. Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. The American Academy of Neurology affirms the value of this statement as an educational tool for neurologists. Stroke. 2009;40:2276–93. doi: 10.1161/STROKEAHA.108.192218. PMID: 19423857.

6 Yanagawa Y, Isoi N, Tokumaru AM, Sakamoto T, Okada Y. Diffusion-weighted MRI predicts prognosis in severe hypoglycemic encephalopathy. J Clin Neurosci. 2006;13:696–9. doi: 10.1016/j.jocn.2005.02.027. PMID: 16815017.

7 Lee YE, Lee EJ, Lee SE, Park J. Predictors of consciousness improvement in patients with hypoglycemic encephalopathy. Front Endocrinol (Lausanne). 2022;13:956367. doi: 10.3389/fendo.2022.956367. PMID: 36051391.

8 Maekawa S, Aibiki M, Kikuchi K, Kikuchi S, Umakoshi K. Time related changes in reversible MRI findings after prolonged hypoglycemia. Clin Neurol Neurosurg. 2006;108:511–3. doi: 0.1016/j.clineuro.2005.02.004. PMID: 15908105.

Conflicts of interest and funding

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