Profound postoperative hypoglycemia in a malnourished patient

[Hypoglycémie postopératoire sévère chez une patiente dénutrie]

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Purpose: To present an unusual case of profound postoperative hypoglycemia resulting in irreversible brain damage in a malnourished patient.

Clinical features: A 56-yr-old malnourished woman underwent laparotomy for intestinal obstruction under general anesthesia. Five hours postoperatively she was found to be unresponsive with an immeasurably low blood glucose level. This event was not associated with hyperinsulinemia. Predisposing factors like diabetes mellitus, pheochromocytoma, insulin secreting tumours, adrenal or pituitary deficiency were absent. She was treated with iv dextrose and hydrocortisone with blood glucose levels stabilizing fairly rapidly. However, she unfortunately had sustained irreversible cerebral damage and is left with significant neurological disability.

Conclusion: Severe postoperative hypoglycemia has several well documented causes. Although hypoglycemia does occur to a moderate degree in malnutrition, it has not been reported to be so severe as to cause cerebral damage in the postoperative setting.

Objectif : Présenter un cas inhabituel d'hypoglycémie postopératoire sévère entraînant un dommage cérébral irréversible chez une patiente dénutrie.

Éléments cliniques : Une femme de 56 ans, dénutrie, a subi sous anesthésie générale une laparotomie pour obstruction intestinale. Cinq heures après l'opération, elle a été trouvée comateuse et présentait un taux de glucose sanguin extrêmement bas. Cette situation n'a pas été associée à l'hyperinsulinémie. On n'a pas trouvé non plus de facteurs prédisposants comme le diabète sucré, un phéochromocytome, des tumeurs sécrétant de l'insuline, une déficience surrénalienne ou hypophysaire. La patiente a été traitée avec du dextrose et de l'hydrocortisone iv et le taux de glucose sanguin a été nettement stabilisé. Elle avait malheureusement subi des dommages cérébraux irréversibles et a été affectée d'incapacité neurologique importante.

Conclusion : On connaît certaines causes de l'hypoglycémie postopératoire sévère. Mais, quoique l'hypoglycémie survienne modérément dans la malnutrition, on n'a jamais rapporté de cas assez sévère pour causer un dommage cérébral postopératoire.

A 56-yr-old woman presented with vomiting and abdominal distension of five days duration. She had surgery for intestinal volvulus four years previously, following which she remained symptomatic with repeated episodes of partial intestinal obstruction. These had always responded to conservative measures in the past. Apart from a history of weight loss during the last four years, she did not have any significant medical problems and was not on any medication. Since her symptoms did not improve with conservative management this time, she was scheduled for an exploratory laparotomy. Preanesthetic assessment was unremarkable except for the fact that she appeared malnourished with a body mass index of 13.94 (weight 38 kg height 165 cm). She was well hydrated and the routine laboratory studies including blood sugar were within normal limits.

Following application of routine monitoring (electrocardiography, ECG; non invasive blood pressure, pulse oximetry, capnography) and preoxygenation, anesthesia was induced with 175 mg of thiopentone sodium, 50 µg of fentanyl, and suxamethonium 75 mg. Cricoid pressure was applied upon loss of consciousness and the trachea was intubated. Anesthesia was maintained with N₂O:O₂ (70–30%) and isoflurane (0.5–1% end tidal). Ventilation was adjusted to maintain the end tidal CO₂ at 4.2–4.6 kPa. Muscle relaxation was maintained by intermittent boluses of 10 mg atracurium to a perioperative total of 40 mg. She was

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also given 6 mg of morphine, 4 mg of ondansetron and 1.2 gm of co-amoxiclav during the procedure. During laparotomy, adhesions from the previous surgery were divided along with a band which was found occluding the jejunum. General anesthesia lasted for one hour and 30 min and there was no excessive bleeding during the procedure. Intraoperatively her blood pressure ranged from 110–90/ 80–60 mmHg, heart rate between 68–86 beats·min⁻¹. She received a total of 1500 mL of lactated Ringer's solution and 500 mL of gelatine (Gelofusine™, B. Braun Medical Ltd, Sheffield, United Kingdom) and urine output was 120 mL. At the conclusion of the case, muscle relaxation was reversed with 2.5 mg of neostigmine and 500 µg of glycopyrrolate and her trachea was extubated when she was fully awake. She was then transferred to the recovery room for further monitoring. In the recovery room, the respiratory rate was 12–16 breaths·min⁻¹ and oxygenation was well maintained (SpO₂ 96–99%) breathing 4 L·min⁻¹ O₂ via a face mask. Her blood pressure ranged from 124–110/ 60–80 mmHg and heart rate 80–92 beats·min⁻¹. The patient was alert, oriented and vocalizing normally. She was monitored for two hours and received a further 2 mg bolus dose of morphine during this period and was later sent back to the surgical ward with a 4% dextrose in 0.18% saline infusion running at 125 mL·hr⁻¹ and supplemental oxygen, with instructions for hourly monitoring of heart rate, blood pressure, respiratory rate and urine output. Five hours after surgery she was found unresponsive in the ward. Her heart rate was 112 beats·min⁻¹ blood pressure 96/50 mmHg and the arterial hemoglobin saturation was 97% by pulse oximetry. Arterial blood gas analysis done at the time showed pH 7.39, Pco₂ 5.18 kPa, Po₂ 14.01 kPa, HCO₃⁻ 23.5 mmol·L⁻¹, base excess -0.7 mmol·L⁻¹, SpO₂% 97.2 at FiO₂ 0.4. Blood glucose was found to be immeasurably low. Fifty millilitres of 50% dextrose were administered intravenously followed by an infusion of 10% dextrose along with hydrocortisone and warmed *iv* fluids. She was transferred to the intensive care unit for further investigations and treatment. Twelve-lead ECG and chest *x-ray* examination did not show any abnormalities. Serum electrolytes, cardiac enzymes, full blood count and coagulation parameters were within normal range. After eight hours when her serum glucose level peaked at 23.4 mmol·L⁻¹, the 10% dextrose was changed to 5% dextrose. Naso-gastric feeding was commenced after three days with the blood sugar levels stabilizing in the normal range. The patient appeared awake and there were yawning and grunting along with random limb and head movements, but with a complete inability

to respond to commands or communicate. These were associated with Babinski signs, decerebrate posturing and absence of response to visual stimuli. All her brain stem reflexes were intact. A computed tomography scan done on the next day showed no focal lesion. An electroencephalography study showed generalized marked slowing without any seizure activity. Serum insulin concentration determined from the blood sample taken at the time of the hypoglycemic episode was 28 pmol·L⁻¹ (normal range 70 to 145 pmol·L⁻¹).

She underwent further investigations in an attempt to explain the profound hypoglycemic episode. A short synacthen test showed a normal response. A urine test for sulfonylureas was negative. Her thyroid function tests were normal. Eight days after admission, her fasting serum insulin concentration was 30 pmol·L⁻¹ and her C peptide concentration was less than 85 pmol·L⁻¹, at a time when her serum glucose level was 2.1 mmol·L⁻¹. Her insulin autoantibody levels were negative, and serum growth hormone concentration was 10 µg·L⁻¹. Her fasting urine sample was negative for ketone bodies. Her neurological status remained unchanged at a three-month follow up examination.

Discussion

This report describes profound hypoglycemia and irreversible brain damage in a malnourished woman. Postoperative hypoglycemia in this patient was not associated with hyperinsulinemia. Immunoreactive insulin and C peptide levels were appropriately suppressed.¹ Other causes of hypoglycemia, such as adrenal or pituitary insufficiency were excluded. Severe postoperative hypoglycemia is a rare event when predisposing factors like pheochromocytoma, insulin secreting tumours and preexisting diabetes mellitus, liver cell or renal failure are absent, with only one case being found after an extensive literature search.² Although hypoglycemia does occur to a moderate degree in malnutrition, it is not usually severe.³ Such profound hypoglycemia implies that hepatic glycogen reserves as well as gluconeogenic substrate are depleted. This is supported by the lack of stainable glycogen in the liver on autopsy and by the sensitivity to short-term fasts (as in our patient) and in malnourished children⁴. Alternatively, these patients may be unable to mobilize gluconeogenic substrates. In addition, the lack of ketosis in our patient is consistent with markedly depleted fat stores.

Hypoglycemia is dangerous because glucose is the primary energy substrate of the brain. Its absence, like that of oxygen, produces deranged function, tissue damage or even death if the deficit is prolonged. The

vulnerability of the brain to hypoglycemia is due to the fact that it can not utilize circulating free fatty acids as an energy source, in contrast to other tissues of the body. Ketone bodies are efficiently oxidized by the brain and can protect the central nervous system from damage by hypoglycemia when present at moderate concentrations in the plasma. However, ketogenesis requires a number of hours and may not take place in the face of severe fat depletion. As cerebral oxidation proceeds without exogenous glucose, the lipid and protein components are metabolized, and irreversible damage occurs.⁵

Prompt diagnosis and treatment of hypoglycemia can reverse neurological symptoms, which however did not happen in our patient resulting in a tragic outcome. A high index of suspicion should be present when malnourished patients undergo surgery and regular monitoring of blood glucose concentrations is recommended to avoid such unfortunate outcomes.

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