

Case Report

Hypoglycemia-induced Bispectral index changes during Coronary Artery Bypass Surgery (CABG): A case report

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Abstract

Background: Diagnosing hypoglycemia is a widely known challenge for anesthesiologists during the perioperative period, especially under general anesthesia, during which many signs and symptoms would be masked. On the other hand, the bispectral index, which has recently been utilized to measure the depth of anesthesia, may be influenced by other factors such as hypo and hyperglycemia.

Cases Report: Herein, we have presented a case of a patient who experienced an abrupt decrease in the Bispectral index following hypoglycemia.

Conclusion: Although the Bispectral index is widely used to monitor anesthesia depth, it can be utilized to continuously monitor other contributing factors such as glycemic condition, hypothermia, hypovolemia, and cerebral ischemia.

Keywords: Hypoglycemia, Induced bispectral index, Coronary artery bypass surgery

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Introduction

Perioperative blood glucose management has always been a major challenge for medical teams, especially anesthesiologists. Blood glucose levels below 70 mg/dL are generally considered hypoglycemia. Hormonal defense systems like glucagon and adrenaline typically activate when blood glucose levels fall, which in turn causes symptoms like trembling, sweating, and dysphoria¹. However, spontaneous blood glucose concentrations less than 50 mg/dL may often be detected in people with diabetes

or healthy individuals with little to no symptoms after a prolonged fast^{1,2}. Patients with diabetes who have had the disease for a long time or who have strict glycemic control may have frequent episodes of hypoglycemia and, even at deficient glucose levels, not exhibit the usual warning signs³. In addition, during the intraoperative period, many of these symptoms may be diminished.

On the other hand, numerous electroencephalogram (EEG) based index systems have been extensively investigated and implemented in clinical settings recently, including the bispectral index (BIS), patient

safety index, Narcotrend, and entropy. These devices serve as monitors of hypnotic levels, utilizing processed EEG data. After being approved by the FDA, BIS has been recognized as a valuable tool for guiding anesthesia administration, particularly in elderly patients^{4,5}.

In anesthesia, the bispectral index (BIS) is frequently used to measure the depth of anesthesia and the effects of hypnotic and anesthetic medications. Nonetheless, a variety of physiological and medical circumstances, such as hypoglycemia, hypothermia, or hypovolaemia, might modify electroencephalography (EEG) and cause the BIS monitor to display an inaccurate hypnotic state⁶.

Moreover, hypoglycemia will increase morbidity and mortality after both cardiac and non-cardiac surgeries⁷. In this study, we will describe a patient who suffered hypoglycemia during surgery and how the Bispectral index was influenced.

Case Report

The patient was a 69-year-old male who had undergone Coronary Artery Bypass Surgery (CABG). The patient was given consent for this case report. He had suffered from Diabetes Mellitus type 2 and hypertension in the last 20 years and was under treatment with multiple oral agents for the diseases mentioned above. Following a recent heart attack and diagnosis of three-vessel disease, he became a candidate for open heart surgery. On the day of surgery, he had not taken his glycemic control drugs as was ordered in the anesthesia preoperative visit.

The echocardiography before surgery revealed a left ventricular ejection fraction of approximately 35-40%, grade 2 diastolic dysfunctions, as well as mild anteroseptal and apical hypokinesia.

Anesthesia was induced by 500mg sodium thiopental, 20 mcg sufentanil, and 100 mg atracurium and maintained by 1 MAC sevoflurane and atracurium. Advanced monitoring, including continuous arterial blood pressure monitoring, brain oximetry, and BIS, was utilized in addition to standard monitoring. The total duration of surgery was 3 hours, including 30 minutes of cardiopulmonary bypass time with no special events. At the end of the surgery, BIS and cerebral oximetry had abruptly decreased. Initially, the head and neck position were checked; meanwhile,

blood pressure was 100/60 mmHg without any inotropes, and gas analyses were also normal. The patient's hemoglobin and hematocrit levels were reported to be 8.9 mg/dL and 32% respectively. Blood glucose was also measured, which was 60 mg/dL; 50 ml of dextrose water 50% was prescribed accordingly to treat hypoglycemia; the BIS began to rise. At the end of the surgery, the patient was transferred intubated to Cardiac Intensive care and was extubated the next day after becoming fully conscious. No obvious neurologic deficit was found, and the patient was discharged a week later.

Discussion

In the present case, we confronted an abrupt decrease in BIS to zero, attributed to hypoglycemia, and recovered to normal values for anesthesia as hypoglycemia was treated.

Mahaldar et al. also reported a similar case who underwent CABG surgery. They reported that BIS rapidly decreased to 22 to 26 while aortic purse strings were taken for cannulation. Sevofurane concentration and ventilatory or hemodynamic parameters have not changed over and after this period. Severe hypoglycemia was discovered; 25% glucose, 50 mL, was administered in a minute. It was observed that after 3 to 5 minutes, the BIS increased quickly to 45 to 49. A blood sugar test resulted in 7.2 mmol/L (130 mg/dL) of glucose. Therefore, hypoglycemia and its subsequent correction were blamed for the alterations in BIS, and no neurologic deficit was seen afterward⁸.

Chunhua Xi et al. also reported two diabetic cases who became severely hypoglycemic during general anesthesia for retinopathy surgery. They also confronted decreased BIS, which was improved by glycemic control⁹.

The excitatory and inhibitory postsynaptic activities in the cortex are mostly reflected in the electroencephalogram, a mixture of brain electrical activity¹⁰. The alpha/theta ratio is sensitive to changes in the EEG during hypoglycemia in adults, with the alpha/theta ratio decreasing as the theta activity increases at a median BG value of 2.0 mmol/L. When BG falls to less than one mmol/L, the EEG becomes flat¹¹, as occurred in our case, although the hypoglycemia was not as severe as mentioned in the last sentence.

We anesthesiologists mostly use BIS as a valuable tool for monitoring the depth of anesthesia. However, we should be aware of other factors that may influence changes in BIS values. For example, a decrease in BIS values during surgeries, especially during cardiac surgeries in patients with known atherosclerosis, can be an important sign of cerebral ischemia¹². In our study, cerebral oximetry did not change; the patient's normal neurologic physical examination also ruled out this diagnosis.

Another essential factor that can lower BIS is hypothermia, which decreases BIS values¹³; however, in our case, this abrupt decrease of BIS was not associated with the patient's temperature as it was constant during this period.

When interpreting BIS values, one should think about factors other than the hypnotic state that can alter EEG, namely anesthetics like N₂O and Ketamine, electromagnetic interference in the operating theater, effect of conditions such as hypoglycemia, cerebral ischemia, hypovolemia, hypothermia and even cardiac arrest and basic EEG pattern abnormalities due to patients past neurologic history⁵.

Conclusion

Although the Bispectral index is widely used to monitor anesthesia depth, it can be utilized to continuously monitor other contributing factors such as glycemic condition, hypothermia, hypovolemia, and cerebral ischemia.

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