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*Case Report*

# Bispectral analysis in a patient scheduled for thoracic aortic aneurism surgery: spurious values?

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**Abstract:** Bisspectral analysis (BIS®) may be the most used way to measure the depth of anesthesia. As a simple device, the monitor can show doctors values captured by a sensor attached to the patient's forehead. These values vary from zero (very deep anesthesia) to 100 (awake patient). Ideally, BIS® should be between 40 and 60 during general anesthesia, but spurious values have been described in some articles, and in this case report, we show a situation that may never been reported in the literature.

**Keywords:** Intraoperative monitoring; Cardiac procedures anesthesia; General anesthesia; Electromagnetic pollution.

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## 1. Introduction

BIS® monitoring has been used for more than 20 years [1]. It seems to be an easy-to-use device that shows doctors the depth of anesthesia of a patient during a surgical operation or sedation in hospital locations like Intensive Care Units (ICU). Its principal utility is to reduce the risks of oversedation or awakening. As BIS® has only a small monitor, a cable, and a sensor and is very intuitive, it has become very popular. Numbers are used to show how deep anesthesia is in every moment, from zero (deep anesthesia) to 100 (awake patient), and a suppression rate analyzer for moments of no central nervous system (CNS) activity [2].

The main problems with this relatively new technology are very common interferences from less important ones like that caused by electrocautery (in general for only a few seconds) to longer interferences caused by cardiopulmonary bypass (CPB), warming blankets or other devices and hypothermia and drugs like ketamine and neuromuscular blockers. Some cases reported in the literature lead us to difficulty understanding and managing these extraordinary BIS® values [3, 4]. The different levels in the case report probably have never been reported before.

## 2. Case Report

A 68-year-old man, 80 kg 1,77 m American Society of Anesthesiologists (ASA 3 – hypertension) without neurologic deficits, was scheduled for a thoracic aortic aneurism under CPB and hypothermia. Monitoring was a 5-lead electrocardiogram, pulse oximetry, and median artery pressure (MAP). A central intravenous catheter was also introduced. Induction of anesthesia was made with midazolam 2mg, fentanyl 500 mcg, etomidate 15mg, and rocuronium 50mg. Propofol 2mcg/ml and remifentanil 3ng/ml under continuous infusion were used for maintenance, and 500mcg fentanyl was injected just before

sternotomy. Everything was fine, and BIS values were between 45 and 55. Twenty min after the start of CPB, BIS® moved to 90 without clear reasons. At this moment, blood pressure was 66 mmHg, and esophageal temperature was just 28OC. Etomidate 10mg and propofol 100mg were made at intervals of 3 min.

As BIS® was still around 90, 5mg midazolam was made 5 minutes later, and subsequently, BIS® dropped to near zero. Flumazenil 0,5mg was injected, the BIS devices (monitor, cable, and sensor) were changed, the BIS® cable was disconnected from the power inlet, and the aorta cannulae were reassured. Still, for two hours, BIS® remained between 0-5, and all the vital signs remained at acceptable levels (MAP 50-60mmHg). At the end of CPB, BIS® levels moved to normal (40-50). As it was a long operation, we decided to leave the patient under sedation until the next morning. The next day, the patient was drowsy but could respond to simple commands. His extubation was realized, and no neurologic deficits were present. The patient had no complaints like awakening during the surgery.

## 3. Discussion

Since the market launch, some reports of spurious BIS® values in different situations were reported and related to drugs, like ketamine, or to electrical devices (CPB machine, warming blankets, monitoring machines) and deep hypothermia [5]. Sometimes, BIS® moves to falsely high levels, miming superficial anesthesia, but clinical judgment is essential [4]. In this case report, the measures were very high even after etomidate and propofol. It seems weird that after 5mg midazolam, they dropped to near zero and remained like this for around two hours despite all the maneuvers, including flumazenil.

One article from 2023, maybe the first, showed a relation between midazolam 2mg and a decrease in the BIS® index of only 3,0, very far from our report [6]. The CPB interference is probably the reason for such high numbers, but it isn't easy to find a reason for a near zero BIS®. Trying to move up these levels is evident as some studies show an association between low BIS® and patient morbidity and mortality, which is a big concern for this patient. However, a large clinical trial does not show this relationship [7]. Two questions: were these low levels true or false? What could be done about this? Changing the device, using flumazenil, and conducting other conducts were unsuccessful.

Fortunately, the patient was extubated without any neurology deficit, but this was a case of an operation under CPB and hypothermia with possible neurological protection. Sometimes, we try to explain a very rare situation, but we can fail. A case report published in 2024 showed us a bizarre problem: massive doses of rocuronium and cisatracurium did not lead to an acceptable train-of-four in a patient in two different operations but not some months later [8].

## 4. Conclusion

In our opinion, the main reason for the high BIS® levels was electromagnetic interference from the CPB machine, but we couldn't find any reason for such a low BIS® for 2 hours (this is our third similar case, unfortunately not recorded). Maybe the most important attitude is using our clinical judgment, observing the other monitoring information, and not only BIS® levels, although it is a very good monitor. Exception cases always happen.

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