CASE REPORT

Should we monitor with bispectral index in all patients at high risk for seizures in the operating room?

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Abstract   We report the case of a patient with a cerebral aneurysm, located in the left middle cerebral artery. During the clipping of this aneurysm, the bispectral index (BIS) increased for no apparent reason. This was then interpreted as intraoperative non-convulsive status epilepticus. This clinical condition may have negative impact in the prognosis of the patient, so it is very important to be able to detect this conditions as early as possible. Measuring the BIS while the patient is anaesthetised could be useful in this situation, considering that an increase in values greater than 60, associated with acidosis and without any other peri-anaesthetic explanation, may provide evidence of a convulsive equivalent state, allowing appropriate action to be taken. © 2012 Sociedad Española de Anestesiología, Reanimación y Terapéutica del Dolor. Published by Elsevier España, S.L. All rights reserved.

¿Deberíamos monitorear el índice biespectral a todos los pacientes con alto riesgo de convulsiones en quirófano?

Resumen   Presentamos el caso de un paciente con un aneurisma cerebral localizado en la arteria cerebral media izquierda. Durante el clipaje del aneurisma, el índice biespectral (BIS) aumentó sin causa justificada. Esto se interpretó después como un estado de mal epiléptico no convulsivo en el seguimiento intraoperatorio. Este cuadro clínico podría tener un impacto negativo en el pronóstico del paciente, de modo que es sumamente importante detectar esta situación tan pronto como sea posible. En este contexto, mientras el paciente esté anestesiado, el BIS podría ayudar, teniendo en cuenta que un aumento a niveles superiores a 60 asociados con acidosis y sin otra explicación perianestésica podría ser indicio leve de un equivalente convulsivo, en cuyo caso se deben tomar las medidas apropiadas. © 2012 Sociedad Española de Anestesiología, Reanimación y Terapéutica del Dolor. Publicado por Elsevier España, S.L. Todos los derechos reservados.

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**Introduction**

Intraoperative non-convulsive status epilepticus in patients with aneurysms is an uncommon clinical condition and its incidence has not been described. It has been associated with large aneurysms and with those involving the middle cerebral artery. The presence of these risk factors requires the anaesthesiologist to monitor brain function during surgery so that these events may be treated in time in order to decrease the subsequent damage. If access to a regular electroencephalogram (EEG) (considered as the gold standard) is not available, the use of a bispectral index (BIS) monitor should be considered for detecting changes in brain activity in patients at high risk.

**Case report**

We report the case of a 65-year-old woman, diagnosed with an aneurysm at the bifurcation of the left middle cerebral artery (LMCA) using cerebral CT angiography. She had suffered two self-limiting episodes of vertigo and paresthesia that began in the lower limbs and then progressed cephalad, with no motor compromise, or loss of consciousness, or nausea and vomiting. The patient was scheduled for elective clipping of the aneurysm.

Propofol, midazolam, remifentanil and vecuronium were used for induction and maintenance of anesthesia. Norepinephrine and remifentanil were infused. Norepinephrine was needed to maintain mean arterial pressure between 70 and 80 mmHg, not exceeding 0.02 μg/kg/min. Prior to the beginning of the procedure, BIS monitoring was initiated. An A-2000 BIS XP monitor (version 3.11, Covidien, USA) was used, with a unilateral sensor located at the right frontal side of the head. Intravenous propofol (2 mg/kg bolus and an infusion at 300 μg/kg/min) was used for suppression, achieving BIS values of 8 with a suppression rate (SR) of 91% (Fig. 1). This state was quite difficult to maintain, with several peaks that produced increase in BIS and a low rate of suppression. Because of this, high doses of anesthetics were administered. Twenty minutes after suppression attempt, BIS values rise to 61, while SRs were at 9% (Fig. 1), without an immediate apparent cause. At that time, the patient was hemodynamically stable, anesthetic drugs were being infused as usually required, and intense neuromuscular blockade was present (TOFr 0). A bolus of 100 mg of propofol was then administered, but BIS values remained elevated reaching up to 60 during clamping of the aneurysm. Ten minutes later BIS values dropped to 40 with a SR of 50%.

On extubation, the patient remained in a deep slumber state, with adequate ventilation. Residual neuromuscular blockade and opiate effects were reversed with neostigmine and naloxone respectively. Postoperative arterial blood gases revealed metabolic acidosis with lactate elevation. The patient was reintubated and a CT scan, CT angiography and MRI of the brain were performed, showing postsurgical changes with permeable arteries and a left temporal hematoma of 3.2 × 1.2 cm that did not cause middle line displacement. Effacement of the sulci of the left frontal convexity was seen, and was due to edema. None of these findings gave a full explanation for the awareness impairment.

Twenty-four hours later, the patient regained consciousness. A right brachial–crural hemiparesis was present. Due to the left temporal hematoma associated with metabolic acidosis, lactate elevation and high BIS during surgery, unrelated to anesthesia depth variations, a non-convulsive status epilepticus was retrospectively suspected. The mental impairment on extubation was interpreted in the context of a postictal state. Treatment with phenytoin was initiated. Recovery was rapid. An EEG obtained at this moment was normal. The patient was discharged home two weeks after surgery without neurologic signs or symptoms and that condition persisted in the evaluations for 6 months and one year afterwards.

**Discussion**

To our knowledge this is the first case described in which a sudden rise in BIS values in the operating room was attributed to an intraoperative epileptic non-convulsive status.

The purpose of the BIS monitoring device is to obtain a complex signal (EEG), analyse it and turn it into a “number” that reflects the presumed level of hypnosis in a patient under general anesthesia. This number has a value from 0 (deep sedation) to 100 (awake).1 A value between 40 and 60 has been associated with a low probability of waking up. Nevertheless, it is not 100% specific,2 and only detects the electrical activity of a limited area, in contrast to a formal EEG, thus some epileptogenic focus may not be detected.

Previous reports have described that, in addition to the use of determining the depth of hypnosis, BIS could also detect non-convulsive seizures by identifying abnormal EEG waves. The changes in BIS associated with seizures may vary, being in the low range in a slow wave crisis, in the high range coincident with a fast wave crisis, or even without changes due to the effects of anesthetic drugs. BIS monitoring has been used in patients at high risk of convulsions in the postoperative period, being particularly useful when a formal EEG is not available.3–5

Tallach et al.4 reported a case of a patient with status epilepticus in which a BIS of 94 was seen during seizure activity, with a typically epileptiform picture on the EEG. The

![Figure 1](image-url) High values of BIS (61) with suppression ratio of 9% were observed, with maximal doses of propofol and the patient clinically asleep.
administration of propofol decreased the BIS number to 28 after seizure control. Chamorro et al. described two cases of comatose patients with non-convulsive status epilepticus. In both cases, the BIS was higher than 60, with a SR between 15 and 30. Musialowicz et al. studied the usefulness of BIS for propofol anesthesia as a treatment for refractory status epilepticus. Under this condition BIS increased from 30 to a mean of 64. They explained that this phenomenon could reflect sudden transitions between low amplitude and slow negative EEG wave activity. Recently, Fernández-Torre et al. concluded that although EEG remains the gold standard for cerebral monitoring, the use of BIS might be helpful in monitoring patients with comatose non-convulsive status epilepticus.

In our case, a patient with a cerebral aneurysm was monitored with BIS during surgery. Cerebral aneurysms are a rare cause of seizures, but attention must be paid when an aneurysm is unusually large (>25 mm) and is situated in the middle cerebral artery, as it could cause seizures. In patients at high risk for convulsions, such as those with cerebrovascular disease, developmental disorders, head trauma, brain tumors, central nervous system (CNS) infection or degenerative CNS diseases, it is important to remain alert in order to detect convulsions during anesthesia and surgery, because non-convulsive status epilepticus may have a negative prognosis. Under general anesthesia, BIS could help, but EEG, although it may not be available at all times, should be considered as the gold standard.

In conclusion, BIS values greater than 60, associated with acidosis and without any other anesthetic or surgical explanation, might be an evidence of a non-convulsive epileptic state, requiring appropriate treatment after mandatory confirmation with an EEG.

Conflict of interest

The authors declare no conflicts of interest.

References