

## Intraoperative visualisation of 3 Hz spike-wave epileptic discharges in the electroencephalographic signal of bispectral index monitor in a patient with absence seizures

Dear Editor,

Bispectral Index (BIS®) is a validated processed electroencephalographic (EEG) tool to monitor the anaesthetic depth.<sup>[1]</sup> We present a novel finding in which 3 Hz spike-waves were clearly detected in the EEG signal of BIS® in a patient with absence seizures under general anaesthesia.

A 12-year-old boy with refractory epilepsy underwent left vagal nerve stimulator placement. Preoperative raw EEG revealed activation of bilateral frontotemporal 3 Hz spike-wave discharges characteristic of absence seizures [Figure 1a]. BIS® Quatro Sensor (Medtronic, Dublin, Ireland) was placed over the left frontal area and was linked to the Philips BIS® module. EEG of the BIS® monitor was set at 200  $\mu$ v and 50 mm/sec speed. Anaesthesia was induced with intravenous (IV) fentanyl 2  $\mu$ g/kg and propofol 2 mg/kg, and the trachea was intubated after IV administration of cis-atracurium (0.2 mg/kg). The BIS® value dropped to 40 immediately after induction, and a slow frequency pattern was observed, which is characteristic of general anaesthesia [Figure 1b]. Air and nitrous oxide (N<sub>2</sub>O) mixture with sevoflurane minimal alveolar concentration of 1 was used to maintain a BIS® value of 40–50, and IV cis-atracurium was infused at 2  $\mu$ g/kg/min. Approximately 30 min after the surgical incision, the EEG signal from BIS® showed sudden spike-wave bursts at regular intervals with suppression of background EEG activity, which was associated with an abrupt increase in the BIS® number to 72 [Figure 1c, arrows]. The cautery and other electrical interferences due to vagal nerve stimulator placement were ruled out, and the BIS® sensor impedance check was satisfactory. The frontal electromyography (EMG) artefact was ignored because the patient had been adequately paralysed with a train-of-four count of 1–2. An IV propofol bolus (1 mg/kg) resulted in complete suppression of the BIS® EEG signal and a decrease in BIS® value, as well as disappearance of the spike-wave discharges [Figure 1d]. The epileptic activity

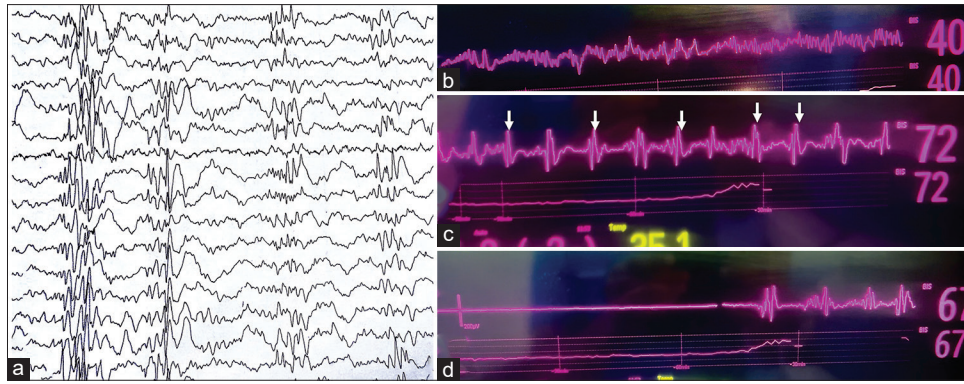
reappeared intermittently on the BIS® monitor's EEG signal with suppression of background EEG activity and was terminated with repeated IV propofol boluses. There were no spike-wave discharges in the EEG signal of BIS® after termination of sevoflurane at the end of surgery.

The fluctuation of the BIS® number has previously been used to detect intraoperative seizures.<sup>[2]</sup> Absence seizures are characterised by bisynchronous, symmetrical spike-wave discharges at 3 Hz frequency and have not been reported intraoperatively.<sup>[3]</sup> In absence seizures, the thalamocortical network and the frontal lobes are involved in the generation of spike-wave discharges.<sup>[4]</sup> These can be easily detected in the EEG tracing of the BIS® monitor as they occur rhythmically with suppression of background EEG activity. Also, the BIS® algorithm considers both EEG and electromyography (EMG) components during its calculation. In a non-paralysed/inadequately paralysed patient under anaesthesia, generalised seizure or seizure propagation during the absence of seizures causes facial muscle contraction, and the BIS® value rises due to an increase in the EMG component rather than the EEG component. In contrast, increased BIS® value during a seizure in a paralysed patient under anaesthesia is caused by abnormal EEG activity. Propofol boluses terminated the absence of seizures effectively, and sevoflurane anaesthesia was continued. Although sevoflurane can lower the seizure threshold, the addition of N<sub>2</sub>O reduces the likelihood of sevoflurane-induced epileptiform discharges, which was the rationale in our case.<sup>[5]</sup>

We emphasise that absence seizures can present with increased BIS® values during anaesthesia with adequate muscle relaxation. Also, vagal nerve stimulation did not cause any significant persistent artefactual change in the BIS number in our case. As the frontal lobe is frequently involved in absence seizures compared to other seizure types and as the 3 Hz spike-wave discharges are rhythmic, BIS® EEG signal can be used to detect them intraoperatively.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the parents consented to the images and other clinical information of the patient to be reported in the journal. The parents understand that the patient's name and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.



**Figure 1:** (a) Preoperative raw EEG (frontotemporal montages) showing 3 Hz spike–wave discharges characteristic of absence seizures. (b) BIS® EEG signal following intravenous anaesthesia induction showing slow waves without epileptic discharges. (c) Intraoperative BIS® EEG signal showing clear epileptic spike–wave bursts at regular intervals (arrows). (d) Complete suppression of BIS® EEG signal with ongoing disappearance of spike–wave bursts following intravenous propofol bolus. BIS = bispectral index, EEG = electroencephalogram

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**ORCID**

Balaji Vaithialingam: <https://orcid.org/0000-0001-6332-3251>

Satish Rudrappa: <https://orcid.org/0000-0002-1106-4371>

**Balaji Vaithialingam, Satish Rudrappa<sup>1</sup>**

Departments of Anaesthesiology and <sup>2</sup>Neurosurgery, Sakra World Hospital, Bengaluru, Karnataka, India

**Address for correspondence:** Dr. Balaji Vaithialingam, Second Floor, Second Cross, Skanda Nivas, Gundappa Gowda Garden, Ejjipura Main Road, Vivek Nagar, Bengaluru – 560 047, Karnataka, India.  
E-mail: balamedicine04@gmail.com

**Submitted:** 26-Jul-2023

**Revised:** 11-Nov-2023

**Accepted:** 12-Nov-2023

**Published:** 29-Jan-2024

**REFERENCES**

1. Rani DD, Harsoor S. Depth of general anaesthesia monitors. *Indian J Anaesth* 2012;56:437-41.

2. Kim H, Kim SY. Pitfall of bispectral index during intraoperative seizure -A case report. *Korean J Anesthesiol* 2013;65:449-52.  
3. Proposal for revised classification of epilepsies and epileptic syndromes. Commission on classification and terminology of the International League against epilepsy. *Epilepsia* 1989;30:389-99.  
4. Pavone A, Niedermeyer E. Absence seizures and the frontal lobe. *Clin Electroencephalogr* 2000;31:153-6.  
5. Kurita N, Kawaguchi M, Hoshida T, Nakase H, Sakaki T, Furuya H. Effects of nitrous oxide on spike activity on electrocorticogram under sevoflurane anesthesia in epileptic patients. *J Neurosurg Anesthesiol* 2005;17:199-202.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Access this article online	
Quick response code	Website: <a href="https://journals.lww.com/ijaweb">https://journals.lww.com/ijaweb</a>
	DOI: 10.4103/ija.ija_710_23

**How to cite this article:** Vaithialingam B, Rudrappa S. Intraoperative visualisation of 3 Hz spike–wave epileptic discharges in the electroencephalographic signal of bispectral index monitor in a patient with absence seizures. *Indian J Anaesth* 2024;68:209-10.  
© 2024 Indian Journal of Anaesthesia | Published by Wolters Kluwer - Medknow