# When the intra-operative neuro-monitoring techniques crossed swords with the electro-encephalogram monitoring!

Dear Editor,

A 56-year-old gentleman with a thoracic intra-dural extra-medullary lesion underwent a T7-9 hemi-laminectomy and excision. Intra-operative neuro-monitoring (IONM) with transcranial motor evoked potentials (TcMEPs), spontaneous electromyography (EMG), and triggered EMG were performed. The stimulating electrodes for MEP monitoring were placed at the C3-4 montage, and the recording electrodes were placed in lower limb muscles. Total intravenous anesthesia (TIVA) was administered with propofol and fentanyl. The depth of anesthesia (DOA) was titrated with Sedline® Monitor with the patient state index maintained between 25 and 45. Although the nerve root stimulation was being monitored, artifacts in the EEG waveform and the density spectral array occurred, interfering with ability to monitor EEG [Figure 1a]. TcMEP stimulation was performed, which also caused transient electrical interference [Figure 1b].

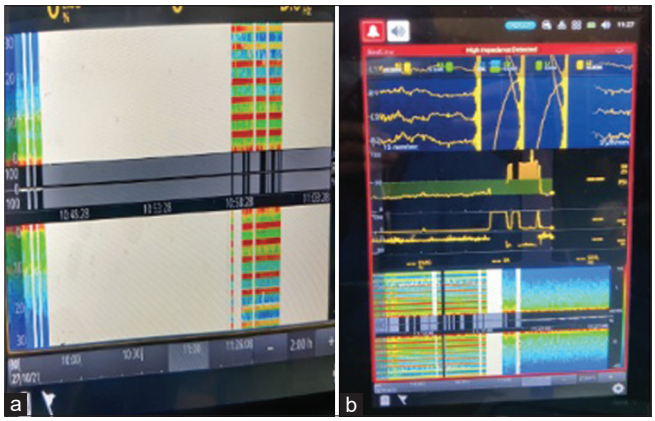

**Figure 1:** (a) Loss of density spectral array (DSA) because of failure of the capture of EEG signals by the Sedline® monitor. (b) Artifacts produced during MEP monitoring in the Sedline® monitor

A right fronto-temporal craniotomy and excision in a 7-year-old child with right frontal pilocytic astrocytoma was performed with dynamic white matter (DWM) stimulation monitoring. Sedline® was used to monitor DOA and titrate TIVA. During DWM stimulation, which was used throughout tumor resection for a period of 2 hours, DOA monitoring could not be assessed because of interference caused by electrical stimulation delivered through the suction probe, making it impossible to rely on Sedline® to titrate DOA [Figure 2].

Processed EEG (pEEG) monitors are being used for monitoring DOA, especially during TIVA. Despite advancement in artifact recognition and removal techniques (analogue/digital), high amplitude and overlapping frequency artifacts can hinder continuous monitoring of DOA, detection of intra-operative cerebral ischemia, and seizure activity. The pulsation of the superficial temporal artery manifesting as spurious EEG activity can lead to its mis-interpretation.[1] EMG activity can also falsely elevate bispectral (BIS) values.[2] The nerve stimulator used for facial nerve monitoring can cause a false increase BIS because of increasing EMG activity.[3] The numerical values obtained during the use of electrocautery should be interpreted with caution.[4]

Algorithms described for artifact production are cryptic for most pEEG monitors (usually available through initial patents/exhaustive review articles).[5] Steps to circumvent the problem of electromagnetic noise are to ensure minimum impedance of the electrode by checking the green icon color in Sedline®, to place the DOA module away from electrical instruments, ensuring that monitor cords do not cross other electrical wires, and grounding the DOA monitor with the equipotential ground terminal. An additional electrode for EEG assessment inserted away from the surgical site may help mitigate the artifacts caused by both pulsation and extra-ocular muscle/frontal muscle twitching during motor stimulation.

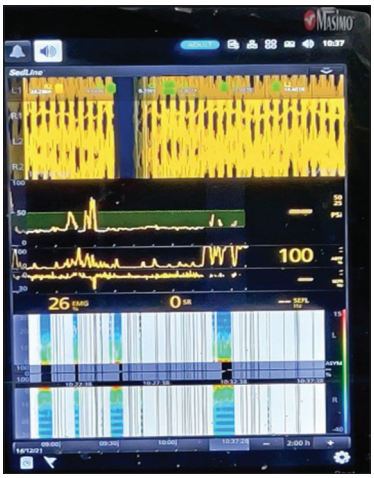

**Figure 2:** Artifacts produced during DWM stimulation monitoring in the Sedline® monitor

When IONM techniques are used, noise can be mitigated by using a bipolar electrode for EP monitoring, thereby ensuring the shortest path for passage of electrical current and reduction in contamination of EEG by ensuring that the vector of current is perpendicular to the recording electrodes. Placement of the ground electrode between the active and reference electrodes of the EEG monitor helps to eliminate common-mode signals.

Artifact production in the Sedline® monitor because of IONM techniques, which when used continuously, can hinder the ability to monitor DOA and the need to be aware of its implications.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

**Keta Thakkar, Dhritiman Chakrabarti[1], Srinivasa Babu Krothapalli[2], Georgene Singh**

Department of Neuroanaesthesia, Christian Medical College, Vellore, Tamil Nadu, [1]Department of Neuroanaesthesia and Neurocritical Care, National Institute of Mental Health and Neuro Sciences, Bangalore, Karnataka, [2]Department of Neurological Sciences, Christian Medical College, Vellore, Tamil Nadu, India

**Address for correspondence:** Dr. Georgene Singh, Department of Neuroanaesthesia, Christian Medical College, Vellore - 632 004, Tamil Nadu, India.
E-mail: georgenesingh@gmail.com

## References

1. Kamata K, Lipping T, Yli-Hankala A, Jäntti V, Yamauchi M. Spurious electroencephalographic activity due to pulsation artifact in the depth of anesthesia monitor. JA Clin Rep 2021;7:35.
2. Bruhn J, Bouillon TW, Shafer SL. Electromyographic activity falsely elevates the bispectral index. Anesthesiology 2000;92:1485-7.

3. Chakrabarti D, Surve RM, Bs D, Masapu D. Intraoperative aberrant bispectral index values due to facial nerve monitoring. J Clin Anesth 2017;37:61-2.
4. Chan MTV, Ho SS, Gin T. Performance of the bispectral index during electrocautery. J Neurosurg Anesthesiol 2012;24:9-13.
5. Bruhn J, Myles PS, Sneyd R, Struys MMRF. Depth of anaesthesia monitoring: What's available, what's validated and what's next? Br J Anaesth 2006;97:85-94.



**Access this article online**

**Quick Response Code:**

**Website:** https://journals.lww.com/joacp

**DOI:** 10.4103/joacp.joacp_96_22

**How to cite this article:** Thakkar K, Chakrabarti D, Krothapalli SB, Singh G. When the intra-operative neuro-monitoring techniques crossed swords with the electro-encephalogram monitoring! J Anaesthesiol Clin Pharmacol 2023;39:662-4.

**Submitted:** 11-Mar-2022 **Revised:** 17-May-2022
**Accepted:** 17-May-2022 **Published:** 20-Dec-2023