

# Can Bispectral Index be a Point-of-care Monitor for Sleep Quality Assessment in Critically Ill Patients?

Indu Kapoor<sup>1</sup>, Hemanshu Prabhakar<sup>2</sup>

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In the last few decades, recommendations have been made to assess and manage sleep quality for patients in intensive care units (ICUs). Polysomnography (PSG) is considered a gold standard method for assessing the quality of sleep. It includes multiple modalities like electromyogram (EMG), electroencephalogram (EEG), and electrooculogram (EOG), which not only assesses the quality of sleep but also helps in the diagnosis of sleep-related disorders.<sup>1</sup> However, in some patients and due to surrounding environmental factors, few practical and technical constraints exist while performing PSG tests. Also, the bulky nature of the instrument and the high cost of PSG does not make it a point-of-care monitor in ICUs.

Bispectral index (BIS), being a processed EEG-based device, has been studied by the authors as an alternate method for assessment of sleep quality. In our clinical practice, BIS monitoring is commonly used in assessing the depth of anesthesia during surgery.<sup>2,3</sup> Several studies have used BIS as a monitor to assess sleep, albeit with contradictory results. This could be due to similarities in EEG synchronization between sleep and anesthesia. Being a simple monitor that is readily accessible when compared with PSG, BIS can easily be used for investigating sleep in patients admitted to the ICU. It is known that BIS is computed by the mechanized processing of EEG data. In the experimental setting, the correlation between BIS and sleep is well-known,<sup>1</sup> however, there are few studies demonstrating the use of BIS monitoring systems for assessment of sleep in the ICU.<sup>4,5</sup>

In a study by Giménez et al., the authors evaluated the reliability and practicability of BIS for monitoring sleep. The investigators collected complete PSG recordings at baseline and after 40 hours of sleep deprivation. They found that the BIS correlated with the hypnogram.<sup>1</sup> The BIS value decreased progressively as the sleep deepened and increased during REM sleep. The authors suggested the BIS monitors as a useful measure of the depth of sleep-in situations such as ICU. They proposed that BIS monitoring could be an alternative for sleep monitoring. This would reduce PSG-derived costs and increase capacity in ambulatory care.

Nicholson et al. recorded sleep patterns in ICU patients using the BIS as an EEG measure of sleep. They observed that none of the ICU patients showed a completely normal sleep pattern. They noted that about half of them showed 40–90 minutes cyclical periods of slow-wave sleep, approaching a normal sleep pattern.<sup>4</sup> In a randomized controlled trial of 24, critically ill patients received oral melatonin 10 mg or placebo for four consecutive nights. Their nocturnal sleep pattern was monitored using the BIS. It

<sup>1,2</sup>Department of Neuroanaesthesiology and Critical Care Neurosciences Centre, All India Institute of Medical Sciences, New Delhi, India

**Corresponding Author:** Hemanshu Prabhakar, Department of Neuroanaesthesiology and Critical Care Neurosciences Centre, All India Institute of Medical Sciences, New Delhi, India, Phone: +91 9818727319, e-mail: prabhakaraiims@yahoo.co.in

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was expressed in terms of sleep efficiency index (SEI).<sup>5</sup> The use of melatonin was found to be associated with a 1-hour increase in nocturnal sleep. There was a decrease in BIS AUC suggestive of better sleep. A small descriptive case series of five patients by Sleigh et al. also suggests the possible role of BIS in monitoring the depth of sleep. In this case series, increasing the depth of sleep decreased the BIS. This was very similar to the decrease in BIS that occurs during general anesthesia.<sup>6</sup> In a recent observational study, the authors evaluated the variability and validity of BIS in critically ill patients. They observed that the BIS has a limited role in monitoring the sleep of lucid patients and also in patients with low-to-moderate disease severity in the ICU. They found that patients with greater total sleep time and volume, along with higher continuous sleep volume, had a better overall sleep perception.<sup>7</sup>

In the current issue of this journal, Sirilaksanamon et al. studied 33 postoperative patients admitted to the ICU and monitored with both BIS and PSG during the first postoperative day. When comparing subjects with poor and good postoperative sleep quality, the main postoperative outcomes were statistically not different. Though all delirious patients had poor postoperative sleep quality, the incidence of delirium between the groups was insignificant. The authors in their study concluded that the BIS is a viable tool for evaluating sleep quality in mechanically ventilated patients in the postoperative ICU with acceptable precision. However, this study is not without limitations, which the authors have rightly suggested in their article.<sup>8</sup>

Bispectral index is a noninvasive, user-friendly method of assessing the quality of sleep in ICU patients. Though expertise is

not required to use this device, its role in assessing the quality of sleep is still at an early stage. A recent systematic literature review was conducted by Richards et al. with an aim to identify measures of quality of sleep in critically ill adult patients hospitalized in the ICU. The authors observed that 62 studies used PSG and other EEG-based methods, actigraphy, and clinicians' observation or patient perception.<sup>9</sup> The authors also commented that their findings were based on a few studies, with small sample sizes, and a short duration of study period. Therefore, they could not make any recommendations on EEG-based measures like the BIS. A pertinent question arises as to whether BIS can be used as a point-of-care monitor to assess the quality of sleep-in patients in ICUs. Possibly, more large multicentric trials are needed to validate the utility of BIS for assessing the quality of sleep in ICU patients.

## ORCID

Indu Kapoor  <https://orcid.org/0000-0002-3065-4940>

Hemanshu Prabhakar  <https://orcid.org/0000-0001-7830-3296>

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