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From Medscape	e Critical Care							
Bispectra David W Crippen,	1 Index: Is It Rea	ady for Prim	e Time	in the	e ICU?		C	Developed and funded by
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Introduction						Contents of	Contents of This Activity	
A great deal of interest in practical electroencephalography is developing in intensive care medicine. Patients are						CME Infor	CME Information	
frequently heavi	ily sedated for their comfort a	and infrequently admir	istered neuro	muscular	blockade (N	IMB) to		
is sometimes di	fficult to accurately assess b	rain function, especial	ly in NMB wh	ere any a	ssessment b	ased on		
physical exam is	s useless. It is important to n	nonitor neurologic fun	tion at all tim	es during	a critical illn	ess, and so it		
has been sugge	ested that a simplified (for the	e observer) electroend	ephalograph	(EEG) mię	ght fill the vo	id between		
obtundation. <sup>[2]</sup>		unit (ICO) physicians	ability to ass	255 11 11 10	ugii the log		•	
Explanation	of EEG							
Thomas P. Blec Neurological Su Care Unit, The I non-invasive na scalp. The comp	k, MD, FCCM, <sup>[3]</sup> The Louise irgery, and Internal Medicine University of Virginia, Charlo ture of EEG, any brain activi pact bone of the skull is relat	Nerancy Eminent Sci ; and Chair, Critical Ca ttesville, Virginia, expl ty signals generated i ively resistant to the t	nolar in Neuro are Committe ained the elec n the cortex n ansmission o	logy and e, Directo ctrophysio nust ultima f weak ele	Professor of r, Neuroscie logy. Becau ately be rece	Neurology, nce Intensive se of the ived at the		

originating closer to the monitor. Challenges facing signal receivers are the difficulties resolving small amplitudes and unmasking summated signals. The sensitivity and selectivity of the technology needed to interpret such signals and translate them into comprehensible data must be of a very high order. The modern processed EEG is sufficiently sensitive and does not require as many head electrodes to generate a satisfactory signal that can be utilized for useful clinical data in the ICU. Filters are used to reduce the recognition of frequencies unlike real brain activity. These filters tend to reduce very low and high frequency activity. Advantages of the processed EEG are that the data are more easily interpreted by physicians not specifically trained in electroencephalography and that it accentuates trends in brain wave activity, which may be more obscure in the older analog modes. Modern processed EEG sorts data into recognizable patterns, including:

- Symmetry -- asymmetrical patterns can indicate diminished perfusion to one hemisphere, cerebral embolism, or thrombosis.
- Amplitude -- the strength of brain wave vectors. Decreased amplitude suggests commensurate brain activity.
   Frequency -- the distribution of vectors throughout all frequency bands. Lower frequencies suggest increasing somnolence.
- Spectral Edge -- the Activity Edge. Significant dips in one hemisphere compared with the other suggest focal brain ischemia.

The principle wave seen in normal wakefulness is the alpha rhythm containing waves of 8 to 12 Hz and is very responsive to changing mental activity, increasing with excitement and decreasing with tranquility. Beta rhythm frequently occurs in the prefrontal regions and is indicative of the initial exphoric, anxiolytic, and amnesic stage of sedation. Both theta and delta waves are frequently seen normally during sleep. The administration of neurotransmitter active medications, such as narcotics and benzodiazepines, produce characteristic changes in the patterns of brain waves that are easily interpretable on the cerebral function monitor.

# **Recent Advances in Processed EEG Monitoring**

A recent advance in the realm of processed EEG is the bispectral index (BIS).<sup>[4]</sup> Dr. Bleck defined BIS as: "An attempt to derive a weighted parameter that reflects both the fast and slow components of the EEG, and gives special prominence to periodic activity." In his presentation, Dr. Bleck suggested that the BIS may be useful in the assessment of neurologic function for ICU patients because simplicity is its essence. The range of therapeutic obtundation is easy to understand and titrate in real time (see Table).

### Table. Bispectral Index Scale

100	Awake				
80	Sedated				
60	General anesthesia				
40	Deep hypnosis				
20	Burst suppression				
1	Flat line				

## **Controversies Surrounding BIS Monitoring**

There are some reports in the literature that suggest the BIS is reasonably accurate in predicting awareness or correlating with sedation scores during therapeutic obtundation<sup>[5-7]</sup> and decreasing dosages of agents needed to yield adequate anesthesia.<sup>[8]</sup> The usual artifacts, eye blink (low frequency), and muscle electrical activity (high frequency) seem to be adequately sorted out for usage in assessing gross changes in awareness. In the end, Dr. Bleck suggested that (processed) EEG "could help to prevent over- or under-sedation of ICU patients, especially those receiving NMB." He suggested that use of the BIS might also speed ventilator weaning (by analogy to the daily wake-up), decrease complications of immobility, decrease unplanned extubations, and decrease ICU staff workload. In conclusion, Dr. Bleck suggested that the BIS may be a more reliable measure of cortical function than the clinical rating scales

Alternatively, Stanley A. Nasraway, MD,<sup>[9]</sup> Chief, Surgical Critical Care and Associate Professor, Tufts/New England Medical Center, Boston, Massachusetts, presented a less optimistic picture of BIS. Dr. Nasraway suggested that there are no convincing data to evaluate the use of the BIS in the ICU. Virtually all of the current data are from short-term use in operating theaters. Dr. Nasraway suggested that the current literature does not necessarily support the proposition that BIS accurately measures awareness under therapeutic obtundation,<sup>[10-12]</sup> and its use is not necessarily cost effective.<sup>[13]</sup> Dr. Nasraway suggested that the ICU is a very different environment from operating theaters in terms of monitoring brain function. Studies demonstrating efficacious cerebral function monitoring in the ICU suffer from weak statistical correlation, and the aggressive marketing practices of the Aspect Company are not borne out in evidence-based medicine. He concluded that BIS may get better in time, but it is not yet ready for ICU practice.

### Conclusion

In conclusion, there does not yet appear to be a meaningful consensus on monitoring brain function in the ICU and that default has prompted skepticism among critical care providers.<sup>[14]</sup>

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Contents of Highlights of the 33rd Critical Care Congress of the Society of Critical Care Medicine (SCCM)

- 1. Bispectral Index: Is It Ready for Prime Time in the ICU?
- 2. Glucose Control in the ICU: Is It More Insulin or Less Sugar?
- 3. Research Determines Best Practices for Treatment of Sepsis
- 4. Cerebral Ischemia: Advances in Diagnosis and Management
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