

Bispectral Index: pros and cons

Dr A Absalom, Consultant Anaesthetist, Addenbrooke's Hospital, Cambridge, UK

Introduction

During inhalational anaesthesia end-tidal agent monitoring can give an estimate of the arterial and brain anaesthetic agent concentrations. In contrast, for TIVA, there is no real-time method of monitoring blood concentrations of the agents. We know the infusion rate and, if we have a target-controlled infusion (TCI) system, then we also have an estimate of the blood concentration, but this is only an estimate, which may be inaccurate if the pharmacokinetic model is not appropriate for the individual patient. Thus during TIVA we have both pharmacokinetic and pharmacodynamic uncertainty, and this, combined with the serious consequences of administering too much or too little anaesthetic agent, underpins the argument for using an objective measure of the clinical effect of the intravenous anaesthetic agents.

The most commonly used measure of anaesthetic depth is the Bispectral Index (BIS). BIS monitors such as the A-2000 (Aspect Medical Systems, Newton, USA), perform mathematical analyses of the scalp electroencephalogram (EEG) to calculate and display an indexed number between 0 and 100 (0 represents no brain activity and 100 represents the fully awake state). The precise mathematical algorithm has not been published, but it is known that the BIS is the weighted sum of 3 sub-parameters, each of which are derived by a different process. Thus the BIS is a composite of time domain, frequency domain, and bispectral analysis EEG parameters.

Pros

The chief advantage of the BIS are as follows:

- It has been subjected to intense scientific scrutiny
- There is a large body of scientific literature concerning the BIS
- There BIS has been used in a large number of patients worldwide
- The BIS monitoring has been shown to correlate with depth of sedation and hypnosis
- BIS monitoring has been shown to reduce drug doses and costs, and to improve the speed and quality of recovery
- BIS monitoring has been shown to reduce the incidence of awareness in patients at high risk of awareness

Cons

Like all monitors that rely on analyses of the spontaneous, cortical EEG, BIS has the following disadvantages:

1. It is poor at predicting whether or not a patient will respond to a painful stimulus
2. It can produce a paradoxical output when agents that increase or maintain cortical electrical activity are used (examples include ketamine, xenon and nitrous oxide).
3. The monitor is susceptible to artefact. In non-paralysed patients in particular, high frequency electromyogram signals from activity in the muscles of the forehead, eyes and face, can cause spuriously high BIS values.

References

1. Rampil IJ: A primer for EEG signal processing in anesthesia. *Anesthesiology* 1998; 89: 980-1002
2. Sebel PS. et al: A multicenter study of bispectral electroencephalogram analysis for monitoring anesthetic effect. *Anesth Analg* 1997; 84: 891-9