Correspondence

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Does bispectral analysis add anything but complexity? BIS sub-components may be superior to BIS for detection of awareness

Editor—We read with interest the analysis of Miller and colleagues1 who found that SyncFastSlow, the bispectral parameter of the bispectral index score (BIS), is not superior to the analogous power spectral parameter. In their study, they calculated Power-FastSlow, the logarithmic ratio of the power of high frequency components (40–47 Hz) and total frequency content (1–47 Hz).
In their analysis, prediction of an awake or anaesthetized state was mainly attributable to the change in high frequency content of the EEG. We wish to congratulate the authors for their interesting findings.

The BIS algorithm contains an additional parameter, the Beta Ratio, which is the logarithmic ratio of high frequency components (30–47 Hz) and classic EEG frequency components (11–20 Hz).2 Inspired by the findings of Miller and colleagues, we decided to evaluate the performance of Beta Ratio and SyncFastSlow in the separation of awareness from unconsciousness. For this purpose, we re-analysed a previously reported study that had produced a very challenging set of EEG data. These data were from 40 patients with ASA physical status I or II who underwent elective surgery under general anaesthesia, with a period of intended awareness (LOC1). Anaesthesia was increased and Tunstall’s isolated forearm technique3 was used during neuromuscular block with succinylcholine. After tracheal intubation, propofol or sevoflurane were stopped until return of consciousness (ROC1). Propofol or sevoflurane were re-started to induce LOC2. After surgery, drugs were discontinued, and ROC2 was observed. Monitoring included standard anaesthesia parameters, EEG, Patient State Index (PSI), and

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**Fig 1** (A) Beta Ratio (the spectral component of BIS), (B) SyncFastSlow (the bispectral component of BIS) and (C) BIS (the composed index) at loss of consciousness (LOC1), awareness reaction (ROC1), loss of consciousness after the awareness reaction (LOC2), and at return of consciousness at the end of anaesthesia (ROC2). Graphs show individual values, mean (black line) and standard deviation (dashed line) in all patients. Triangles are used for sevoflurane/remifentanil group 1, circles for sevoflurane/remifentanil group 2, squares for propofol/remifentanil group 1, and diamonds for propofol/remifentanil group 2. Prediction probability (P_k) (see) for awareness is given for each index. Beta Ratio had the highest, BIS the lowest P_k.
BIS (Aspect A-1000, BIS version 3.3, Aspect Medical Systems Inc., Newton, MA, USA) derived from recommended electrode positions. EEG electrode impedances were <5 kΩ. The high pass was set at 0.25 Hz, no low pass was used, and the notch filter (50 Hz) was enabled. The EEG was continuously digitized at 256 Hz per channel and simultaneously with the other monitoring parameters recorded on a personal computer. Beta Ratio and SyncFastSlow, two sub-components of the BIS were calculated from the digitized EEG from a 15 s time window with a 15 s averaging interval for parameter smoothing. For analysis, values at the last command before and at LOC and ROC were used (Fig. 1). Prediction probability (Pk) of the Beta Ratio and SyncFastSlow were calculated and compared to the previously reported Pk of BIS. Statistical analysis was performed with two Excel Macros, PKMACRO and PKDMACRIO, provided by Warren D. Smith Ph.D. (Professor, Biomedical Engineering Program, California State University, Sacramento, CA, USA). Pk values were compared using t-scores for paired data. We found that the Pk of the Beta Ratio was 0.825 (0.023) (Pk (SE)), and Pk for SyncFastSlow was 0.731 (0.028). Interestingly, Pk of both subcomponents was higher than Pk of BIS (0.685 (0.029)). Thus, we conclude that for the separation between awareness and unconsciousness, SyncFastSlow, the bispectral component of BIS related to the complexity of the EEG signal, may not add much information. In addition, in our data only the spectral component Beta Ratio separated awareness from unconsciousness to a greater degree than the composed parameter, BIS.

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Editor—We thank Dr Schneider and his colleagues for their interest in our work. We are also encouraged to see that the conclusions obtained from their analysis and data are very similar to our conclusions—namely that bispectral analysis of the EEG does not contribute greatly to the detection of loss of consciousness. The bispectral analysis may contribute to EEG quantification at higher concentrations of general anaesthetic. However, this remains speculation until such time as Aspect releases the details of how the three subcomponents of BIS are combined to produce the final index.

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2. Rampal IJ. A primer for EEG signal processing in anesthesia. Anesthesiology 1998; 89: 980–1002

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ETT impingement during railroading over the FOB

Editor—I would like to thank Drs Macnair and Barker for their letter. I agree that the tracheal tube of the ILMA ETT is effective in reducing impingement. The ILMA ETT and the double setup ETT have not been compared in a randomized, controlled trial, so it is uncertain which is more effective in reducing impingement. However, the ILMA ETT does appear to have two advantages: it is simple to prepare and it can be used for nasal intubations. The double setup ETT requires knowledge of which uncuffed ETT fits inside which cuffed ETT, and what length to cut the cuffed ETT. This may be a deterrent to its use, especially for occasional practitioners of fibreoptic intubation. Also, the double setup ETT is too short for nasal intubations. In contrast, the double setup ETT may be preferred for long-term intubation because of its low-pressure cuff. As noted in Drs Macnair and Barker’s letter, the ILMA ETT has a high-pressure cuff.

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2. Lucas DN, Yentis S. A comparison of the intubating laryngeal mask airway (ILMA, Intavent), and available to buy separately, supersedes the technique described. Lucas and Yentis, for the orotracheal route and Barker and colleagues for the nasotracheal route both showed the ILMA tube had a impingement rate of 0%, and Barker’s trial was blinded to the assessor. Though some concerns may be raised concerning the high-pressure cuff of the ILMA tube, the benefits of easy first-time placement of the ETT in awake fibreoptic intubation cannot be underestimated.

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Editor—I would like to thank Drs Macnair and Barker for their letter. I agree that the tracheal tube of the ILMA ETT is effective in reducing impingement. The ILMA ETT and the double setup ETT have not been compared in a randomized, controlled trial, so it is uncertain which is more effective in reducing impingement. However, the ILMA ETT does appear to have two advantages: it is simple to prepare and it can be used for nasal intubations. The double setup ETT requires knowledge of which uncuffed ETT fits inside which cuffed ETT, and what length to cut the cuffed ETT. This may be a deterrent to its use, especially for occasional practitioners of fibreoptic intubation. Also, the double setup ETT is too short for nasal intubations. In contrast, the double setup ETT may be preferred for long-term intubation because of its low-pressure cuff. As noted in Drs Macnair and Barker’s letter, the ILMA ETT has a high-pressure cuff.

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