

## Commentary

# The use of bispectral index monitors in paediatric intensive care

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See *Research* by Triltsch *et al.*, page 119

### Abstract

The bispectral index (BIS) is a processed neurophysiological electroencephalographic parameter that may be used to evaluate the depth of sedation in critically ill children. Triltsch and colleagues attempted to correlate BIS scores with a commonly used clinical sedation scoring system. They were able to demonstrate good correlation during deep sedation and in cases where the electrical impedance of the BIS electrodes was lowest. Studies have shown only moderate degrees of correlation between BIS scores and clinical sedation scoring systems. There is currently insufficient evidence to recommend routine monitoring of BIS scores in critically ill children.

**Keywords** bispectral index, neurophysiological, paediatric intensive care unit, sedation

### Introduction

In this issue of *Critical Care*, Triltsch and colleagues [1] report on the use of the bispectral index (BIS) as a monitor of sedation in the paediatric intensive care unit (PICU). They attempted to correlate BIS scores with the COMFORT score – a commonly used clinical sedation scoring system. The authors were able to demonstrate good correlation between BIS scores and COMFORT scores during deep sedation and in cases where the electrical impedance of the BIS electrodes was lowest. The stated aim was to determine whether BIS is a useful tool for assessing the level of sedation in critically ill children. In their study, analysis of the BIS score enabled correct prediction of the COMFORT score in 80% of cases overall, but in only 55% of lightly sedated children.

The study population was quite selected in that 85% of patients had undergone cardiac surgery, and children were assessed only in the first few hours of admission to the PICU. This makes the study findings less applicable to a general PICU population, where children are admitted with a much broader range of diagnoses, particularly with neurological dysfunction and altered levels of consciousness, which

would have an impact on the use of BIS scores. The median duration of endotracheal intubation in a noncardiac PICU would typically be in region of 3–4 days, and the utility of BIS as a measure of sedation in critically ill children would therefore have to be assessed during the entire period of sedation rather than just focusing on the first few hours. This is particularly important, given the finding of the authors that analysis of the BIS score would enable correct prediction of the COMFORT score in only 55% of lightly sedated children.

During the course of a period of critical illness, children require different depths of sedation according to their clinical status and the interventions to which they are subjected. Frequently, at the outset of a PICU admission a relatively deep level of sedation is required to allow for the instigation of certain invasive procedures and therapies, particularly in certain specific disease states such as raised intracranial pressure or pulmonary hypertension. As a PICU admission progresses there is usually a requirement for a lighter degree of sedation, and the utility of BIS scores in guiding the titration of sedative agents longitudinally during a PICU admission that includes such periods of lighter sedation remains questionable.

## Previous studies

Crain and colleagues [2] studied 31 mechanically ventilated PICU patients using the BIS score and the COMFORT scale twice daily for up to 5 days and found that individual measurements of BIS score and COMFORT scale were only moderately correlated. The authors concluded that BIS scores may be best used to identify and prevent over-sedation in the PICU.

Berkenbosch and colleagues [3] compared BIS scores with simultaneously obtained clinical sedation scores in 24 mechanically ventilated PICU patients. In differentiating adequate from inadequate sedation, BIS values below 70 had a sensitivity of 0.87–0.89 and a positive predictive value of 0.68–0.84. In differentiating adequate from excessive sedation, BIS values below 50 had a sensitivity of 0.67–0.75 and a positive predictive value of 0.07–0.52. The BIS reliably differentiated between inadequate and adequate sedation, but it was relatively insensitive for differentiating between adequate and over-sedation. The data suggested that 80% of patients were adequately sedated when BIS scores were maintained at less than 70. At BIS scores below 40, fewer than half of the clinical sedation scores were found to indicate excessive sedation, whereas almost half of those determined to be excessively sedated patients on clinical sedation scales had BIS scores in excess of 40.

A group of patients we are particularly anxious to sedate adequately are those receiving neuromuscular blocking agents. These patients are at risk of inadequate sedation and of being able to recall periods of neuromuscular blockade. Aneja and colleagues [4] compared the BIS score with clinical assessment of sedation using the Ramsay score in 24 mechanically ventilated PICU patients. They compared PICU nurses' clinical assessments of depth of sedation with BIS scores of children receiving neuromuscular blocking agents. Nurse assessments detected only 8% of those patients with a BIS score of 80 or greater, and who were therefore at risk for awareness and recall. Nurses clinical assessment for oversedation (BIS <40) had a reasonable sensitivity of 89.7% but a low specificity of 38.6%. That study served to highlight the inadequacy of clinical scoring systems in the assessment of sedation in those receiving neuromuscular blocking agents.

## Conclusion

Triltsch and colleagues [1] have demonstrated that the BIS has potential for monitoring sedation in critically ill children, but that this role has yet to be clearly defined. It must be remembered that the optimal range of BIS scores for varying depths of sedation remain poorly defined and are subject to great variability between patients. Many factors encountered during critical illness, including body temperature variation, hypotension and even critical illness itself, may alter the BIS score, as may drugs such as opioid analgesics, ketamine and nitrous oxide. Electrical interference from PICU equipment

and muscle activity at lighter levels of sedation may both confound BIS scores. There is currently insufficient evidence to recommend the routine use of BIS monitors in the PICU, even in those patients who are receiving neuromuscular blocking agents.

## Competing interests

The author(s) declare that they have no competing interests.

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