The correlation of the bispectral index monitor with clinical sedation scores during mechanical ventilation in the pediatric intensive care unit.
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Abstract: In patients who are mechanically ventilated in the pediatric intensive care unit (PICU), sedative and/or analgesic medications are routinely provided and titrated to effect based on clinical assessment of the patient. The bispectral index (BIS) monitor uses a modified electroencephalogram to quantify the effects of central nervous system-acting drugs on the level of consciousness. To evaluate the usefulness of the BIS monitor to predict clinical sedation levels in the PICU, the authors compared BIS values with simultaneously obtained clinical sedation scores in 24 mechanically ventilated pediatric patients aged 5.7 plus minus 6.1 yr. For each sedation scale used, the BIS value correlated with increasing depth of sedation ($P < 0.0001$) and was independent of the drug(s) used for sedation. To differentiate adequate from inadequate sedation, a BIS value <70 had a sensitivity of 0.87--0.89 and a positive predictive value of 0.68--0.84. To differentiate adequate from excessive sedation, a BIS value <50 had a sensitivity of 0.67--0.75 and a positive predictive value of 0.07--0.52. We conclude that the BIS monitor may be a useful adjunct for the assessment of sedation in PICU patients. IMPLICATIONS: We demonstrate the usefulness of the bispectral index monitor for assessing sedation in pediatric intensive care unit patients. The bispectral index monitor correlated with clinically assessed sedation levels and was useful for differentiating adequate from inadequate sedation, which would be of value when the clinical examination is unavailable.

Commentary:

Since the advent of the practice of sedation and anesthesia, there has been a search for the "Holy Grail" of consciousness monitoring – a simple machine that could indicate how deeply "asleep" a patient is at any time. The bispectral index monitor (BIS) is currently the most widely used "depth of anesthesia" monitor. As described in the abstract above, this monitor is designed to process an EEG signal into a single number (0-100) that indicates depth of unconsciousness. This instrument has been aggressively marketed to anesthesiologists and there is a wealth of literature on its use in the OR setting. We cannot even begin to summarize all the findings of these studies involving BIS technology but we believe it would be fair to say that the instrument "works" as a consciousness monitor; it is less clear as to whether or not it really improves anesthesia delivery to a significant extent. Among some anesthesiologists and institutions the BIS is used as a "standard" monitor and is applied to most patients, while in other locations it has been slow to catch on. (At our institution, it is used in 10% or fewer cases).

The study described above represents a trial of the monitor in the pediatric ICU setting, and should be commended for taking on this complex issue. The authors try to answer the questions as to whether this monitor of consciousness can work in the pediatric ICU environment and how its performance compares to standard sedation scales. They also compare the performance of the BIS in the ICU to that in the OR. As with many ICU studies, difficulties in methodology include

the variety of patient pathology that is involved, lack of true "blinding" during data collection, and relatively small numbers. The results indicate that the monitor is relatively good at identifying inadequate sedation but fairly inaccurate for indicating "over sedation". It does track well with clinical sedation scores. Interestingly, opioids appear to affect the BIS reading more in the ICU setting than in the OR – a finding which may relate to the degree of illness these patients were experiencing compared to elective surgery patients.

Of note, the discussion section is worth reading for anyone interested in the emerging field of sedation depth monitoring. The authors recognize the limitations of their work and put forth reasonable arguments for their conclusions.

After reading this paper we are left with the question, "What is the future of the BIS in pediatric sedation?" The authors of this paper suggest that in ICU patients receiving muscle relaxants, the monitor could be used to assure adequate depth of sedation (since these patients cannot be assessed clinically). Unfortunately, based on the results of this study, the BIS would not be very useful for warning us about too much sedation. It is not certain that this monitor offers much advantage over clinical evaluation in patients who are *not* relaxed.

The question for providers of pediatric sedation outside the ICU would be whether or not a monitor such as the BIS could be used to "titrate" sedation to a given number and avoid the need for provocative testing of sedation depth (i.e. "Johnny can you hear me?"). Stay tuned, as we are sure this will be the thrust of future investigations in this area.

Please contact SPS and let us know about any experience you have with the BIS and sedation monitoring!