

## The utility of Bispectral index score and the modified University of Michigan Sedation Scale in assessing the depth of pediatric sedation

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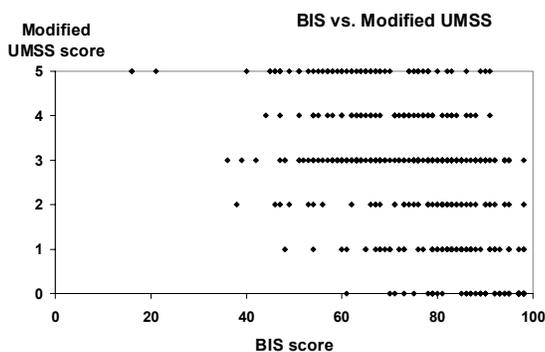
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**Introduction:** Assessing the depth of sedation is an important safety aspect of pediatric sedation practice. This assessment requires a certain amount of stimulation, which can be counterproductive. The Bispectral Index (BIS) monitor (Aspect Medical, Natick, Ma) uses a non-stimulating adhesive probe attached to the forehead to process surface EEG through an algorithm to give a number 0-100 which represents the depth of sedation and accounts for motion artifact. Our objective was to correlate BIS monitor with a validated pediatric sedation scale, the modified University of Michigan Sedation Scale (MUMSS) (1).

**Methods:** After obtaining informed consent from their parents, 38 pediatric patients undergoing sedation had simultaneous BIS scores and modified MUMSS scores recorded every 10 min throughout their sedation, until they were ready for discharge. One of four providers performed the MUMSS. The providers were blinded to the BIS score during the evaluation. The patients were sedated with chloral hydrate or pentobarbital and midazolam for noninvasive procedures (CT or MRI) and with meperidine and midazolam for GI procedures. Sedation was defined as follows: Light, a MUMSS of 0-1 or BIS of 100-80; Moderate, a MUMSS of 2-3 or BIS of 79-60 and Deep, a MUMSS of 4-5 or a BIS of < 60.

**Results:** There were 405 data sets in the 38 patients. The mean age was 5.8 yrs. (17 were < 3 yrs.). The inter-observer reliability for the MUMSS scores between the 4 investigators was excellent. There was however, poor correlation between the BIS score and the MUMSS, Spearman's  $r < -0.506$ . The correlation remained poor when subsets of children < 3 yrs and  $3 \geq$  yrs were evaluated and was far worse in patients who received chloral hydrate compared to other drug regimens  $r < -0.214$ . A cross tabulation between the BIS categories of light, moderate and deep sedation and the MUMSS categories of light, moderate and deep sedation was performed. The agreement between the BIS and MUMSS was poor. The Kappa, which indicates the adjusted % agreement between BIS and MUMSS categories, was 0.167. This means the agreement is only 16% better than that expected by chance. The BIS tended to under estimate the clinical level of sedation. According to the MUMSS, patients were deeply sedated 27% of the time; using the BIS data they were deep 15% of the time. 44% of the patients had MUMSS scores indicating deep sedation at some point during their procedure while 50% of patients had a BIS score < 60 during their procedure, indicating deep sedation.

**Discussion:** BIS and MUMSS do not correlate well. The correlation was particularly poor for patients receiving chloral hydrate. The BIS monitor tended to under estimate the level of sedation. Using either the BIS or the MUMSS to judge the level of sedation reveals that a large number of patients reach a deep level of sedation and that they may spend 25% of the time at this deep level. This finding may have monitoring implications for routine pediatric sedation practice.



1. Malviya S, Voepel-Lewis T, Tait AR, et al. Depth of sedation in children undergoing computed tomography: validity and reliability of the University of Michigan Sedation Scale (UMSS). *Br J Anaes.* 2002; 88: 241-245