Validation of the UMSS and MMWT in sedated children across age groups

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Introduction: The University of Michigan Sedation Scale (UMSS) is a five-point observational scale (0=awake, 4=unarousable) used to assess depth of sedation in the clinical setting (1). Preliminary studies have demonstrated the tool's reliability and/or validity in assessing depth of sedation in children up to 12 years of age (1,2). Furthermore, data in a small number of children under the age of 2 years suggest that the Modified Maintenance of Wakefulness Test (MMWT), a simple visual observation of the time a child is able to maintain wakefulness may provide a valid, reliable and objective criterion to assess discharge readiness following sedation (3). The present study was undertaken to evaluate the reliability and validity of these measures across all pediatric age groups (birth to 18 years of age).

Methods: With IRB approval and parental informed consent, children were studied after receiving sedative agents or general anesthesia. A Bispectral index (BIS) monitor was used to record depth of sedation/anesthesia continuously from baseline to recovery. A trained observer who was blinded to the BIS values assigned UMSS scores at 5 minute intervals or when it was possible to use graded stimulation (i.e. verbal, to light tactile to deep stimulation) for appropriate assignment of the score. A second observer recorded the BIS value immediately prior to stimulation for UMSS assignment. Following the procedure, the child's ability to maintain wakefulness was also assessed using the MMWT timed from the point the child awakened during UMSS assessment to the time the child fell asleep. The study ended when the child's MMWT was $\geq$ 20 mins or when the child removed the BIS probe. BIS values were later averaged for the five minute period immediately prior to the recorded observations to evaluate reliability and stability of the observers' BIS recordings. Data were compared using Pearson or Spearman's rho correlation coefficients and descriptive statistics. $P<0.05$ was accepted as statistically significant.

Results: In this ongoing study, 150 observations have been recorded in 15 children (aged 2-15 yrs, mean 8.5 ± 5.1; 47% male). Sedatives/anesthetics administered alone or in combination included propofol (47%), inhaled anesthetics (67%), midazolam (47%), fentanyl (60%) and morphine (7%). Intraclass correlation coefficient between the observers' BIS recordings and the averaged values was 0.96 indicating a high degree of reliability. The moderate to excellent correlations between UMSS scores, BIS values and MMWT durations support the criterion validity of the UMSS (see table).

	r value*	r^2 value
BIS –UMSS (n=150)	-0.82	0.67
BIS – MMWT (n=24)	0.64	0.41
UMSS – MMWT (n=27)	-0.78	0.61

*$p<0.01$ for all values

The sensitivity of the UMSS score in identifying awake to lightly sedated patients (UMSS of 0-1) who had BIS values >80 was 83%. Additionally, the specificity of the UMSS (scores 2-4) to identify children with BIS values <80 was 94%. Finally, the positive predictive value of the UMSS was 91%.

Discussion: Valid and reliable assessment of depth of sedation is imperative in order to assure the safety of sedated children. The most widely used method to assess sedation depth is the use of an observational scoring tool such as the UMSS. Our data support the criterion validity of the UMSS as a measure of sedation depth in children. Furthermore, the high correlations between MMWT duration, BIS values and UMSS scores provide preliminary support for the use of the MMWT as an additional measure of recovery following sedation. Further analysis of a larger sample is required to examine interrater reliability of the UMSS in older children, and the variance of BIS values and MMWT duration at each UMSS score.

References:

1) Malviya S, et al. *BJA* 2002;88:241-5.
2) McDermott N, et al. *Anesth Analg* 2003; 97:39-43.
3) Malviya S, et al. *Anesthesiology* In press.