Effect of Sedative Agent on Sedation Depth and BIS Values in Children

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Introduction: Previous studies have suggested that Bispectral Index (BIS) may be less reliable in detecting depth of anesthesia or sedation during use of certain anesthetics or sedatives.1-4 These studies suggest that depth of sedation as measured by BIS may be drug-dependent. To date, data related to the effects of sedative agent on BIS in children are limited due to small sample sizes and inclusion criteria. The purpose of this study, therefore, was to evaluate the relationship between BIS and sedation levels as observed using the University of Michigan Sedation Scale (UMSS), under various sedative regimens.

Methods: Data obtained from separate studies from the University of Michigan,5,6 Children’s Hospital of Philadelphia,7 and The Children’s Hospital at Denver1 were subjected to secondary analysis. The original studies included children aged birth to 17 years who were sedated with a variety of agents in accordance with institutional protocols. In each study, children were similarly observed and scored for sedation depth using the 5-point UMSS. BIS values corresponding to these observations were independently recorded in a blinded fashion. Analyses of variance with repeated measures (ANOVA) compared BIS values between each level of sedation for the sedative agent groups. Unpaired t tests evaluated the differences in BIS values at each observed sedation depth between groups. Correlations between BIS and UMSS were made using Spearman’s rho.

Results: Data from 2283 observations in 223 children are presented. 47% of the observations were made in children who had received midazolam (M), 30% in pentobarbital (Pb), 22% chloral hydrate (CH), and 2% propofol (Pf). The figure presents the distribution of BIS values across UMSS levels of sedation for the groups. ANOVA demonstrated significant differences in BIS values across sedation levels for all groups (p < 0.001). Additionally, BIS correlated with UMSS for all sedation groups (table). BIS values in Group M were higher for UMSS scores 1, 2 & 3 (NA for UMSS 4) compared to CH and Pb groups, and higher for UMSS 1 compared to Pf (NA at levels 2&3) (p < 0.024). BIS values in the CH group remained higher at the deepest levels of sedation (UMSS 3-4) compared to Pb and Pf (p < 0.05). These results were similar when children 6 months of age were excluded.

Discussion: This study demonstrates that although BIS values decreased across observed sedation levels for all groups, there were differences in BIS at specific levels depending on the sedative agent used. Not surprisingly, BIS remained highest during sedation with midazolam, and was lowest during propofol and pentobarbital. These findings likely reflect different effects on the EEG of different sedative agents.

Table. Correlations* between BIS and UMSS for groups.

<table>
<thead>
<tr>
<th>Sedative Agent</th>
<th>Correlation (n)</th>
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<tbody>
<tr>
<td>Chloral hydrate</td>
<td>-0.547 (n=498)</td>
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<tr>
<td>Midazolam (n=1064)</td>
<td>-0.465</td>
</tr>
<tr>
<td>Propofol (n=44)</td>
<td>-0.922</td>
</tr>
<tr>
<td>Pentobarbital (n=676)</td>
<td>-0.378</td>
</tr>
</tbody>
</table>

*All were significant at p < 0.01

References:
1) McDermott N. Anesth Analg, 2003;
2) Shields C. Clin Pediatr, 2005;
3) CosteC. Anesth Analg, 2000;
4) Vernon J. Anesth Analg, 1995;
5) Malviya S. Anesthesiology 2004;
6) Malviya S. Anesth Analg, in press;
7) Sadhasivam S. Anesth Analg, in press.