Dexmedetomidine for Procedural Sedation in Pediatric Patients

John McCall MD, Nina B. Lubisch, Post Graduate ARNP, B-C, Rudolph Roskos, MD, Joanne M. Klipper, MS, MHC

Chris Evert Children's Hospital, University of Cincinnati College of Medicine

Introduction: Sedation of children for imaging procedures is often challenging. While not painful, these procedures require patient immobility for as long as three hours. An ideal sedative regimen would provide rapid and reliable onset of effect, maintenance of a patent airway, adequate spontaneous ventilation, continuing cardiovascular stability, and a smooth and predictable awakening.

Approximately 35,000 imaging procedures are performed yearly at the Chris Evert Children's Hospital (CECH) within Broward General Medical Center (BGMC) in Ft. Lauderdale, Florida. Procedures performed include CT, PET, MRI, and Nuclear Medicine exams. In addition to imaging procedures, approximately 1800 electroencephalogram (EEG) and Brain Evoked Auditory Response (BAER) tests requiring sedation are performed annually.

Prior to 2003, CECH exclusively utilized chloral hydrate for moderate sedation. As imaging procedures became longer and more complex, pentobarbital (Nembutal®, Ovation Pharmaceuticals) became the drug of choice with chloral hydrate being reserved for EEG and BAER tests. (See Table I) As the clinical results yielded poor outcomes, it became apparent that this regimen resulted in a 14% failure rate. Failures included awakening during the procedure, paradoxical reactions such as delirium with severe rage, and prolonged awakening. These shortcomings led to prolonged imaging times and added stress to the patients, parents and staff.

Methods: After waiver of consent approval from the Institutional Review Board, retrospective chart review was conducted on patients who received sedation for imaging between January 2004 and June 2005. This time frame begins with the use of Pentobarbital for moderate sedation and extends to the present, in which dexmedetomidine (DEX) has become our drug of choice for moderate sedation. Demographics recorded include age, weight, diagnosis, and duration and type of procedure. Study data recorded includes dose and type of medication (and duration of infusion if DEX utilized), time for effective sedation, ability to complete imaging study, time to awakening, time to discharge, and any untoward effects including rage reaction. The adequacy of sedation was evaluated by the nursing staff using vital signs and the Aldrete Scoring system. Patients were monitored per institutional sedation protocol. DEX delivery began with a loading infusion, followed by a maintenance infusion rate based on the patient response to the loading dose.

Results: One hundred forty five children were sedated with pentobarbital, 548 with DEX (to date 700 children have received DEX successfully). Pentobarbital patients had a mean age of 5.2 ± 0.2. Broader usage of DEX patients ranged from 2 weeks up to 18 ages years old. Time to achieve adequate sedation and time to awakening were significantly less in the DEX group (Table II). Children in the pentobarbital group had recovery times which were unpredictable, and 14% of children in the pentobarbital group experienced paradoxical drug reactions pre, during and post procedures. There were also reports of these reactions occurring hours after the child was discharged. Parent surveys revealed parents missing work the following day due to these reactions.

Discussion: There is growing anecdotal evidence regarding the beneficial effects of DEX use in the pediatric population (Tobias & Berkenbosch, 2002). DEX for procedural sedation has not been associated with respiratory depression or cardiac arrhythmias however hypertension on initial dosing within 1-2 minutes has been observed. We have used DEX for sedation of select pediatric patients for over two years. During this period 700 children, ages 2 weeks to 18 years, received DEX. Other practitioners have shown that DEX significantly decreases amount of time it takes for child to achieve sedation. In our comparison with pentobarbital sedation, we confirm these findings and also found DEX produced a significant decrease in the time to awakening and a nonexistent number of paradoxical reactions/rage reactions. In addition, we found DEX to produce very reliable sedation with 700 plus children. Failure rate compared with pentobarbital was on average 15% with approximately one out of four children experiencing rage. With DEX 0 % failure rate was recorded as well as delirium. Due to the excellent results achieved with DEX, as well as the favorable safety profile, we will continue to use DEX for pediatric imaging sedation. (CECH, 2005)
Table 1: Drug Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Pentobarbital (n= 145)</th>
<th>Dexmedetomidine (n=548)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years (± SEM)</td>
<td>5.2 ± 0.2</td>
<td>4.2 ± 0.2</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Time to adequate sedation (min)</td>
<td>13</td>
<td>7.75</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Time to awakening (min)</td>
<td>157</td>
<td>10.9</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table 2: Age Distribution of Dex in Children

<table>
<thead>
<tr>
<th>Variables</th>
<th>&lt;2 yrs (n = 116)</th>
<th>2-5 (n = 266)</th>
<th>6-10 (n = 138)</th>
<th>11-17 (n = 28)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to adequate sedation (min)</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Time to awakening (min)</td>
<td>2</td>
<td>5</td>
<td>9.6</td>
<td>27</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

All variables were analyzed by Student’s t-tests or nonparametric Wilcoxon rank sum test as appropriate. A p value of less than 0.05 was considered significant.

References
Shukry, M. Dexmedetomidine as the Primary Sedative Agent for Brain Radiation Therapy in a 21-month-old Child.