COMMENTARY

Shifting the Paradigm: The Quiet Revolution of Pediatric Procedural Sedation Practice

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On April 12, 1945, Dr Gold[1] from Weill Cornell Medicine (formerly Cornell University Medical College) presented a review titled "Sedatives and Stimulants in Pediatric Practice" to the section of pediatrics. He stated that he was "disappointed indeed to learn how scant were the revelations of pediatric views on these matters" and then reviewed the primary sedatives of that time for children (barbiturates and chloral hydrate). Over the next 50 years, the vast majority of "conscious" sedation in pediatrics was still being provided with barbiturates and chloral hydrate. Because of this lack of evolution, many of the seminal articles that have been used to guide the mechanics of pediatric sedation practice emanated from 2 sources: data from sedated procedures performed with these traditional long-acting agents and data from general anesthetic cases that were extrapolated to be relevant to procedural sedation. One issue that has been largely governed by these data sets is the risk of apnea and need for prolonged observation in former term and preterm infants after a sedated procedure.

The literature regarding the risk of postanesthetic apnea in infants is robust. Infants who were born prematurely carry the most notable risk, as has been described in a number of reports.[2–6] Apnea has also been seen postoperatively in term infants with no previous history or known risk factors for apnea.[7] In a large, multicenter review in which researchers examined risk factors for postoperative apnea in former preterm infants, postconceptual age (PCA), gestational age, and continued use of a home monitor were found to be the 3 variables independently related to the probability of apnea.[8] The cumulative results of these studies in the 1990s led to the general recommendation for postoperative overnight monitoring for former term infants through 44 to 48 weeks PCA and for former preterm infants through 60 weeks PCA.[8,9]

Only a handful of researchers have looked at procedural sedation in the infant population, and most studies still involve longer-acting agents, such as chloral hydrate and barbiturates.[10–14] In these reports, the risk of intra- and postprocedure oxygen desaturation was strongly correlated with lower PCA and lower chronological age. None of these studies specifically reported any incidents of apnea postsedation. However, in all of these studies, decreased oxygen saturation was monitored as a surrogate for apnea, potentially underestimating the true incidence of apnea.[15]

However, researchers in 3 recent retrospective studies examined the outcomes associated with newer sedative agents for procedural sedation in infants. Najafi et al[16] reviewed 19 infants with a median age of 9 months who received intravenous dexmedetomidine for an MRI. Eight infants were 60 weeks PCA or younger. None of the infants in the study experienced any respiratory complications, although none were specifically monitored for

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postprocedure apnea, and all were discharged within 2 hours. In a recent evaluation of 52 patients <12 months of age, infants as young as 1 month of age received intranasal dexmedetomidine for sedation for an MRI.[17] There were no documented episodes of oxygen desaturation or apnea, although the duration of postprocedure monitoring was not discussed. Finally, Jenkins et al[18] presented findings from a chart review of 304 infants younger than 6 months of age who received propofol for radiologic imaging sedation. Of these patients, 64 were younger than 90 days of age, and 39 were born prematurely, although it was unclear if patients in these 2 groups overlapped. Fourteen infants experienced intraprocedure apnea, but the incidence was not correlated with prematurity. There were no reports of postprocedure apnea; however, it was also unclear how many of the preterm infants had a PCA at <52 weeks of age, which was the criterion used for a 12-hour postprocedure monitoring period.

After reviewing these studies, it is clear that the risk of postprocedural sedation apnea must be evaluated more closely in association with these newer agents. To that end, in this edition of *Hospital Pediatrics*, Rozema et al[19] present a retrospective chart review of deep sedation (DS) encounters in 61 infants <6 months of age, >85% of whom received propofol. Of this sample, 24 were preterm (<37 weeks' estimated gestational age) infants who were <60 weeks PCA, and 37 were term infants <50 weeks PCA. During the same period, 120 preterm and 55 term infants underwent general anesthesia (GA) for herniorrhaphies and were included in a comparison group. All infants in both the DS and the GA groups were monitored, most with an apnea monitor, for at least 4 hours after procedure completion, and the median observation time in both groups was 23 hours. No infants who received DS had a recorded episode of apnea, whereas 3 preterm infants who underwent GA had apneic events in the initial 2 hours of recovery in the postanesthesia care unit. The authors clearly note the limitations of this study: it is retrospective in nature, the sample size is too small to detect rare events, and a significant number of infants who were discharged with <4 hours of postprocedure monitoring were excluded from the study. Although the results did not reveal any incidents of post-DS apnea, the authors appropriately conclude that large prospective multicenter studies with consistent monitoring practices and outcomes metrics are needed and that their findings are in no way sufficient to warrant a change of current postsedation monitoring guidelines.

Beyond the modest conclusion that no instances of postsedation apnea were observed in a small sample of infants who received procedural sedation, what is the significance of this study? It reveals that guidelines and policies, many of which are based on historical, long-acting medications and GA-based regimens, need to be reexamined in light of new procedural sedation techniques and regimens and in the manner in which they are being used by robust, high-quality pediatric procedural sedation programs. Reports such as this are opening the door to new thinking about pediatric procedural sedation and are shifting existing paradigms. It may have taken 40 years to evolve beyond chloral hydrate and barbiturates, but the past 20 years have witnessed a growing revolution in pediatric procedural sedation care.

What is involved in this paradigm shift? Quietly, pediatric providers from disciplines such as critical care medicine, emergency medicine, and hospital medicine have been leading the development of new pediatric procedural sedation standards and practices.[20] Pediatric anesthesiologists are not the sole, or even the majority of, providers of procedural sedation in children, and conclusions drawn from studies in which participants by and large receive general anesthetics may no longer be as relevant as reports in which researchers specifically review procedural sedation outcomes data in children.[21] The Pediatric Sedation Research Consortium, the research arm of the Society for Pediatric Sedation, has collected outcomes data from >500 000 procedural sedation encounters in children in a single, large-volume database that has provided significant insight into sedation safety, adverse events, and interventions, including those in preterm versus term children.[22,23] As evidenced in recent reviews from the Pediatric Sedation Research Consortium database, pediatric procedural sedation programs are safely and effectively using newer agents with more favorable pharmacologic profiles, such as propofol and dexmedetomidine.[24–27] Pediatric procedural sedation provider and team education has been standardized and more widely disseminated through courses such as the Society for Pediatric Sedation's Sedation Provider Course and other high-fidelity simulation-based training.[28] Multidisciplinary pediatric sedation experts have collaborated to develop goals and metrics for safety as well as the other domains of quality in procedural sedation, including efficiency and timeliness, patient and family experience, and effectiveness.[29,30] Finally, large prospective multicenter trials are underway to evaluate procedural sedation regimens as used by robust multidisciplinary pediatric procedural sedation programs and their associated outcomes. With these new data, sedation guidelines and policies can more accurately reflect current practice and outcomes rather than those of the past.

Hopefully, Dr Gold would be happy to see that the discipline of pediatric procedural sedation has seen such revolutionary progress!

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