Propofol Sedation for Endoscopic Procedures in Children

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Background and Study Aims: **Propofol sedation has been used successfully in various outpatient minor procedures in children. Limited data are available on the usefulness of propofol sedation during gastrointestinal endoscopic procedures in children. The aim of this study was to evaluate our experience of propofol sedation in pediatric gastrointestinal endoscopic procedures.**

Materials and Methods: **The charts of all children who had undergone diagnostic endoscopic procedures, and were sedated by propofol, were retrospectively reviewed. Demographic data, cardiovascular monitoring, and drug dosages were recorded. Patients evaluated their sedation efficacy by answering a questionnaire before discharge.**

Results: **A total of 104 children underwent 107 procedures. Propofol alone was given in 19 procedures and in combination with midazolam and/or fentanyl in 88 procedures. All procedures were completed and significant complication occurred in only one patient. No significant difference was observed in the amount of sedative drugs or recovery time between upper and lower endoscopic procedures. A lower propofol dosage was needed when a combination of drugs was given compared to propofol drug alone. Patients' assessment of their sedation showed that the vast majority had experienced postendoscopic amnesia.**

Conclusion: **Propofol sedation for endoscopic procedures is safe and acceptable for children. Propofol sedation should be offered to young children, especially those who express significant anxiety.**

Introduction

Conscious sedation has been accepted as a primary sedation in children during endoscopic procedures [1–3]. Nevertheless, significant side effects and patient dissatisfaction have been reported during such procedures [4]. An uncooperative patient during endoscopic procedure is a well-known phenomenon, especially in school-age children. Accordingly, restraining, "sacking", or Indian papoose board are used to control patients during the procedure. Propofol (Diprivan) is an alternative sedation which could help alleviate the anxiety of patients and their parents. Diprivan is a short-acting sedative drug with a short recovery time [5] and has successfully been utilized in children during minor hematological and/or oncological-related procedures [6, 7]. Only limited data are available on the use of propofol for endoscopic procedures in children [8–10]. Carlsson & Grattidge [11] reported that propofol exhibited better sedation for adult patients who had endoscopic procedures, compared with midazolam. Others [12] showed that propofol sedation, administered by adult patients (patient-controlled anesthesia), was not adequate for pain relief during colonoscopy. In the present study we describe our experience with propofol sedation in children during endoscopic procedures.

Materials and Methods

Patient Populations

The charts of all children who underwent endoscopic procedures at the outpatient endoscopy suite under propofol sedation, between April 1998 and August 1999, were retrospectively reviewed. It is our practice to offer propofol sedation to children who meet the following criteria: (1) children who are younger than 10 years of age; (2) children older than 10 years of age, who had expressed significant anxiety and/or behavioral immaturity during their first medical visit (assessed by the examining physician; Y. E.); (3) children who are scheduled for a colonoscopic proce-

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dure, especially those who had experienced an unpleasant procedure under conscious sedation.

We do not offer propofol sedation to the following patients: (1) children who are younger than 2 years of age; (2) children with significant neurological disability; and/or (3) children for whom the anesthesiologist feels that propofol sedation is inadequate. Parental consent was obtained for the procedure in every patient before the procedure. All procedures were performed in the endoscopy suite at Cabell-Huntington Hospital. Demographic data, vital signs, medication dose, and recovery time (defined as the time lapsed between termination of procedure and discharge time) were reviewed.

Anesthesia Procedure

Endoscopic procedures were carried out without tracheal intubation. Propofol sedation was administered intravenously by the anesthesiologist who was present throughout the procedure. Upon the anesthesiologist's discretion, propofol or other medications, i.e. midazolam or fentanyl, were also used (prior or during the procedure). The sum of all medications given during the procedure were then recorded for the study. All patients had cardiovascular monitoring and continuous oximeter measurement. Oxygen (2–3 l/min) was given to every child during the procedure. An anesthesia consent form was signed by the parents prior to each procedure. Respiratory or cardiovascular complications were recorded by the anesthesiologist at the time of the procedure, and were entered into the reviewed data. Hypoxia was defined as oxygen saturation below 90% over 30 seconds.

Assessment of Sedation Efficacy

Since April 1998, a postsedation questionnaire has been introduced in our hospital. The questionnaire was previously described by Van Houten et al [13], and was designed to evaluate the memory and/or pain experience of the child during the procedure. The questionnaire includes the following questions:

1. Rank how much you remember when the doctor started the procedure.
2. Rank how much you remember during the procedure.
3. Rank the severity of any pain you may have experienced during the procedure.
4. Rank the severity of any pain you may have experienced after the procedure was completed.

Ranking was graded as: none, some, most, and everything/unbearable. The questionnaire was administered by the recovery room nurse, who did not participate in the procedure itself. At the time of the interview, the patient was completely coherent and ready to be discharged.

Statistics. Wilcoxon signed rank, Mann-Whitney analysis, and the Student's t-test were performed to evaluate the difference between the endoscopic procedures and/or drug dosage. StatWorks software (Data Metrics Inc. 1985, Philadelphia, Pennsylvania, USA) was used for all analyses.

Results

A total of 178 upper and lower procedures were performed in the endoscopy suite between April 1998 and August 1999. In 107 (60%) procedures, propofol sedation was used, of which 86 were upper and 21 were lower endoscopic procedures. (Three children had both procedures performed in one session.) All procedures were diagnostic, and none were therapeutic.

Propofol alone was used in 19 procedures, midazolam was added in 56 procedures, and midazolam with fentanyl were added in 32 procedures. Demographic details and drug dosages are described in Table **1**. Children who had lower endoscopic procedures were older than the children who had upper endoscopic procedures. No significant difference was observed in the dose of medications used between upper or lower procedures.

Table 1 Sedation characteristics

	Upper	Lower	P Value*
No. of procedures	86	21	
Male/female ratio	1.3:1	1.6:1	
Age, mean years ± SD	8.7 ± 3.3	10.9 ± 5.0	0.013
Propofol, mg/kg	4.2 ± 2.3	5.9 ± 3.6	0.023
Midazolam, mg/kg	0.04 ± 0.02	0.05 ± 0.03	0.090
Fentanyl, µg/kg	1.4 ± 0.6	1.9 ± 0.9	0.115
Recovery time, h	1.5 ± 0.6	1.5 ± 0.4	0.406

* Mann-Whitney analysis

Except in one patient, no significant side effect from anesthesia was observed during the procedures i.e. hypoxia or Ambu bag assistance, and all procedures were carried out successfully. In one patient, significant apnea with oxygen desaturation was recorded by the anesthesiologist. The child was intubated and oxygen saturation was normalized. The procedure was then completed uneventfully. The anesthetic drugs of this patient included midazolam (0.03 mg/kg), fentanyl (2.28 µg/kg), and propofol (3.8 mg/kg); all were within the mean dose range of the other children who did not develop apnea.

We further divided the children into three groups according to the type of sedation they received including: propofol alone (P), propofol with midazolam (P + M), and propofol, midazolam, and fentanyl (P + M + F). Analysis of the results showed that the propofol dose significantly decreased when a combination of all drugs was used (Table **2**). Interestingly, no significant difference in the recovery time period was observed among the groups (data not shown). Completed postsedation questionnaires were found in only 75

Table 2 Dose of medications

Medications	No. of patients	Propofol dose, mg/kg	P value*
P	19	5.4 ± 2.7	
P + M	56	5.0 ± 3.0	0.627
P + M + F	32	3.1 ± 1.3	0.0009**; 0.001#

P, propofol; M, midazolam; F, fentanyl; * Student's t-test; ** compared with P; # P + M compared with P + M + F

Table 3 Patient questionnaire*

1. Rank how much do you remember about the time period when the doctor started the procedure?			
None 53 (71 %)	Some 14 (19 %)	Most 4 (5 %)	Everything 4 (5 %)
2. Rank how much you remember from during the procedure?			
None 72 (96 %)	Some 2 (3 %)	Most 1 (1 %)	Everything 0 (0 %)
3. Rank the severity of any pain you may have experienced during the procedure.			
None 72 (96 %)	A little 2 (3 %)	A lot 1 (1 %)	Unbearable 0 (0 %)
4. Rank the severity of any pain you may have experienced after the procedure was finished.			
None 62 (83 %)	A little 9 (12 %)	A lot 4 (5 %)	Unbearable 0 (0 %)

* 32 patients did not complete the questionnaire

(72 %) charts. Overall, the sedation efficacy recorded by the patients was favorable. Over 95 % had little or no pain, or had any recollection of the procedure (Table **3**). In spite of the different combinations of drugs given to the groups, there was no significant difference in analgesia score (response to questions 3 and 4 in the questionnaire) among the three groups (data not shown).

Discussion

Endoscopic procedures in children are commonly performed, and are important as a diagnostic tool in the practice of the pediatric gastroenterologist. Although conscious sedation is routinely used for such procedures, significant child restraining (papoose board) and "sacking" are often necessary to adequately complete the procedures. Moreover, with the higher demands in professional qualifications, pediatric endoscopists are required to perform more complicated procedures, i. e. therapeutic procedures, which increase the procedure time. Such requirements further underlined the importance of patient cooperation during the procedure. Several authors have described the difficulties of patient behavior during endoscopic procedures [4, 14], and others [15] suggested that the best outcome of such procedures, as related to complete evaluation, safety, and patient satisfaction, are achieved when sedation is controlled by the anesthesiologist rather than the endoscopist. Although the data on propofol sedation during endoscopic procedures are limited, several preliminary studies have recently been reported. Seal et al [10] reported that propofol provided better sedation and a faster recovery time compared with conscious sedation (diazepam and meperidine). Compared with general anesthesia, propofol sedation was found to be adequately safe and appropriate for children [8]. Concurring with these findings, we report a very good response of children who had propofol sedation during endoscopy. The vast majority of the children had no significant pain during the procedure, and were very satisfied. Only one complication was recorded in all the procedures, suggesting a safe sedation.

Previous data showed that propofol has a faster recovery time but a weaker amnestic property [8 – 10, 16]. In our experience, utilizing amnestic medication, i. e. midazolam, in combination with propofol, improved our outcome. Indeed, the children who had their sedation with multiple medications reported a higher amnesia score, (question 2 results, $p = 0.001$; data not shown). Interestingly, only 71 % of patients reported no recollection about when the procedure was started (question 1). In all patients, the procedure was started only after the patient had entered a deep sedation status, as assessed by no eyelid movement upon stimulation. We thus hypothesize, that, some of the children confused pre-procedure time (ECG electrodes placement, oxygen nasal cannula placement, etc.) with procedure time (introducing the endoscope into the oral cavity).

Pharmacokinetic studies have shown a synergistic effect between propofol and fentanyl [16, 17]. It was thus expected that the propofol dose used during the procedures would be lower in children who were sedated in combination with midazolam and/or fentanyl. Our results showed that a lower propofol dosage was used when fentanyl was included in the combination, compared to propofol alone (Table **2**). No synergistic effect was observed when midazolam was added. Although our data support the pharmacological synergism between propofol and fentanyl in children, it may be biased, as the sedative medications were introduced according to the anesthesiologist's discretion without following a standard protocol. To substantiate our findings, future studies, performed under controlled conditions, are warranted.

The reluctant approach of most endoscopists to propofol sedation in children is primarily related to the need for the anesthesiologist. In the current health care environment of cost saving, such increase in cost needs to be justified. In the present study, we suggest that other factors should be considered in the cost analysis including: patients' safety, parental satisfaction, and the limitation of conscious sedation for longer procedures (sclerotherapy, percutaneous gastrotomy, etc.). An expensive procedure is the one which was not completed, or was unsuccessful due to unacceptable patient behavior during sedation. In a preliminary report, Rosenberg et al [9] suggested that propofol sedation is safe and may be cheaper when performed by a non-an-

esthesiologist physician. We thus conclude that propofol sedation in children is safe, advantageous to the endoscopist, and may also be sound economically.

In summary, we present our experience in 104 children who underwent an endoscopic procedure under propofol sedation. When given by an anesthesiologist, this sedation is safe and adequate for endoscopic procedures in children. We recommend that it should be offered as an alternative sedation, especially for nervous children, and/or to decrease parents' anxiety.

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