Oral Sedation Postdischarge Adverse Events in Pediatric Dental Patients

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The study investigated patient discharge parameters and postdischarge adverse events after discharge among children who received oral conscious sedation for dental treatment. This prospective study involved 51 patients needing dental treatment under oral conscious sedation. Each patient received one of various regimens involving combinations of a narcotic (ie, morphine or meperidine), a sedative-hypnotic (ie, chloral hydrate), a benzodiazepine (ie, midazolam or diazepam), and/or an antihistamine (ie, hydroxyzine HCl). Nitrous oxide and local anesthesia were used in conjunction with all regimens. After written informed consent was obtained, each guardian was contacted by phone with specific questions in regard to adverse events following the dental appointment. Out of 51 sedation visits, 46 were utilized for analysis including 23 boys and 23 girls ranging from 2 years 2 months to 10 years old (mean 5.8 years). 60.1% of patients slept in the car on the way home, while 21.4% of that group was difficult to awaken upon reaching home. At home, 76.1% of patients slept; furthermore, 85.7% of patients who napped following the dental visit slept longer than usual. After the appointment, 19.6% exhibited nausea, 10.1% vomited, and 7.0% experienced a fever. A return to normal behavior was reported as follows: 17.4% in <2 hours, 39.1% in 2–6 hours, 28.3% in 6–10 hours, and 15.2% in >10 hours. Postdischarge excessive somnolence, nausea, and emesis were frequent complications. The time to normality ranged until the following morning demonstrating the importance of careful postdischarge adult supervision.

Key Words: Conscious sedation; Dental treatment; Morphine; Meperidine; Midazolam; Diazepam; Chloral hydrate; Hydroxyzine; Postdischarge adverse event.

Oral sedation ranges along a continuum of varying levels of sedation from minimal to moderate to deep sedation.[1] In minimal sedation, patients respond normally to verbal commands, despite possible impairment of cognitive function and coordination and exhibit normal cardiovascular and pulmonary functions.[1] In moderate sedation, patients respond purposefully to verbal commands with or without light tactile stimulation. At this level, normal cardiovascular and pulmonary functions are expected as well. Patients under deep sedation cannot be easily aroused but respond purposefully to repeated verbal and painful stimuli. Cardiovascular function tends to be normal; however, patients may require assistance in maintaining a proper airway.[1] Because the level of sedation of a patient under oral sedation may move along a gradient, patients at a certain level may progress to a deeper level of sedation; thus, it is imperative for a dental practitioner to be cognizant of the patient's status during and after treatment.[1]

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Although all levels of sedation are generally safe when practiced by qualified health practitioners on appropriately selected patients, serious adverse events during deep sedation may occur ranging from respiratory depression to laryngospasm, brain damage, and death. However, with proper monitoring, training of the clinician and staff, a suitable drug regimen, appropriate patient selection, and adherence to discharge criteria, serious adverse events are rare.[1] Because oral sedation medications exhibit varying half-lives, posttreatment monitoring time will vary with different drug regimens.[1] For medications with long half-lives, not only may the patient take longer to reach his/her original baseline cognitive and physiologic levels, but these medications are also capable of causing resedation.[2]

Previous studies and documented cases have demonstrated that postsedation adverse events frequently involve inability to arouse the patient and/or difficulty breathing. This may be due to premature discharge of the patient and may lead to death.[2–4] Premature discharge may also lead to adverse events that go undetected by a guardian. Thus, specific and objective discharge criteria, such as those stated in the guidelines of the American Academy of Pediatric Dentistry[1] are vital in order to discharge a patient safely.[5] The following discharge criteria are recommended by the American Academy of Pediatric Dentistry: (a) satisfactory cardiovascular function and airway patency; (b) arousable with protective reflexes intact; (c) can talk if age appropriate; (d) can sit up unaided if age appropriate; (e) very young children or children with special needs have reached their presedation level or a level as closely as possible to their presedation level; and (f) adequate state of hydration.

Although serious morbidities are uncommon, lesser postoperative adverse events may be unpleasant and may last for varying amounts of time. Previous studies have investigated postdischarge adverse events following general anesthesia. Mayeda and Wilson[6] found that restorative procedures that involved stainless steel crowns produced more severe complaints compared to restorative procedures without stainless steel crowns or nonrestorative procedures (eg, dental extractions alone). The study also reported that a complete return to normal preoperative behavior often takes more than 6 hours.[6] Martinez and Wilson[7] reported on postdischarge events following oral sedation utilizing 2 regimens: chloral hydrate, meperidine, and hydroxyzine or midazolam alone. In that study, patients who received the mixture of chloral hydrate, meperidine, and hydroxyzine were more likely to sleep on the way home and upon arriving at home, but no differences were seen for other postsedation adverse events associated with eating, postoperative pain, vomiting, evening sleep, and memory. Another recent study reported the most common intraoperative adverse event to be hallucination (3.9%), while the most common postdischarge adverse event was excessive sleep (41.9%) with moderate sedation involving chloral hydrate or midazolam. This study also found that minor adverse events were significantly more likely with high oral doses of choral hydrate than with midazolam.[8] Because oral liquid chloral hydrate has been discontinued by its manufacturer, further investigation of patient discharge parameters of other oral sedation regimens is warranted. Research is needed to evaluate the recovery period of patients who have undergone oral sedation in order to help ensure safety and prevent potential dangers of various adverse events. A better understanding of a patient's time frame to reach his/her baseline status following sedation may help prevent premature discharge and also enhance a clinician's ability to educate the patient's caretakers on postoperative instructions, and thus improve patient safety.

The purpose of this study is to investigate patient discharge parameters and postdischarge adverse events in children who received oral sedation for dental treatment at the Herman Ostrow School of Dentistry of the University of Southern California Pediatric Dentistry Clinic (USCPD).

METHODS AND MATERIALS

Approval for this study was obtained from the University of Southern California Health Sciences Institutional Review Board prior to commencement.

In this prospective study, all pediatric patients who had completed treatment planning and were scheduled for dental treatment under oral sedation were asked to participate. Patients were scheduled for oral sedation following standard protocols at the USCPD, which included a comprehensive oral exam, treatment plan, written informed consent by a legal guardian, assent by patients over age 7, and delivery of preoperative instructions to the legal guardian. All children who received oral sedatives at USCPD had dental treatment using the sedation criteria established by the University of Southern California Pediatric Dentistry Department.

Depending on each patient's preoperative assessment and dental treatment needs, each patient received one of the various regimens utilized at USCPD involving combinations of a narcotic (eg, morphine or meperidine), a sedative-hypnotic (eg, chloral hydrate), a benzodiazepine (eg, midazolam or diazepam), and/or an antihistamine (eg, hydroxyzine HCl) (Figure 1) at the following dosages: 0.66 mg/kg for morphine, 2 mg /kg for meperidine, 0.5–0.7 mg/kg for midazolam, 0.5–.7 mg/kg for diazepam, and 2 mg/kg for hydroxyzine HCl.

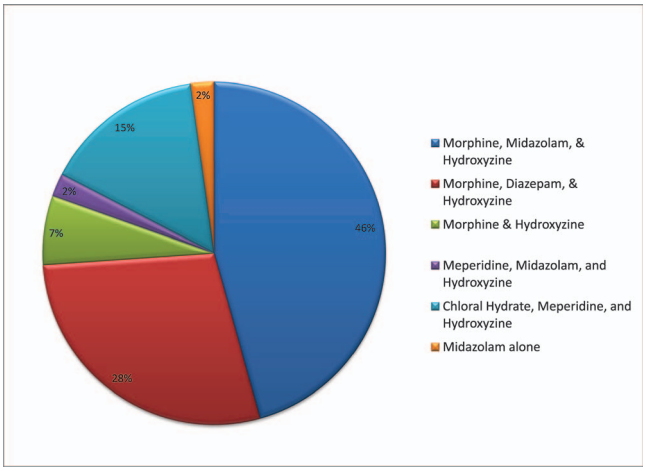

Figure 1. Distribution of oral sedation regimens.

Following the administration of the sedative regimen, patients were monitored according to the American Academy of Pediatric Dentistry guidelines and treated with routine operative care including rubber dam, local anesthesia, and nitrous oxide with oxygen. Lidocaine (2% with epinephrine 1:100,000) was used for local anesthesia in all cases and did not exceed the dosage of 4.4 mg/kg. Forty percent to 50% nitrous oxide with oxygen was administered during settling of the child and maintained throughout the procedure. One hundred percent oxygen was administered for 5 minutes following completion of the dental treatment.

Prior to administration of the oral sedation, consent to participate in the study was reviewed with the guardian of the patient. The guardian was informed that he/she would be contacted by phone and questioned in regards to adverse events within the first 24 hours following the dental appointment. Informed written consent for sedation and dental treatment was also obtained. Participants had the option to read the consent forms on his/her own or to utilize an interpreter. All guardians/participants were informed about their rights to discontinue participation in the study at any time with no consequence.

The day following the sedation, the patient was contacted by phone and a standardized survey was conducted. All surveys were carried out over the phone and all completed surveys were kept in a locked cabinet. The survey was translated into Spanish and was read as printed to guardians who spoke Spanish. All data entered into researcher's computer were saved as a password locked file. Data used for analysis will be destroyed at least 5 years after study completion according to the Committee on Human Studies' research protocol.

The data were stratified for several factors: age, gender, American Society of Anesthesiology (ASA) Physical Status classification, and language of the survey administered. The purpose of this study was not to test and compare different regimens, but to investigate oral sedation discharge parameters and adverse events following oral sedation. The data were also used to compare presedation patient cooperation and behavior with the level and success of the sedation by performing Fisher exact tests.

The statistical analysis was performed by the Clinical and Translational Science Institute of the University of Southern California. Responses were entered into Research Electronic Data Capture and analyzed. Descriptive data, Fisher exact tests, and Cochran-Armitage tests were completed with the significance level set at 0.05.

RESULTS

Responses from 51 caretakers of patients who received oral sedation were collected. Data from 5 visits were excluded from the analysis because it was not the participant's first sedation visit; thus, out of 51 sedation visits, data from 46 were utilized for analysis.

The patient population consisted of 23 boys and 23 girls ranging from 2 years 2 months to 10 years old (mean 5.8 years). 73.9% (34/46 subjects) of patients were healthy ASA I and 26.1% (12/46 subjects) of patients were assessed as ASA II. 17.4% (8/46 subjects) were taking various medications and 8.7% (4/46 subjects) exhibited allergies (Table 1).

Ethnicities of the study's patients varied as follows: 80.5% (37/46 subjects) Hispanic or Latino, 6.5% (3/46 subjects) black or African American, 4.3% (2/46 subjects) white, non-Hispanic, 4.3% (2/46 subjects) Asian, and 4.3% (2/46 subjects) unknown. 69.6% (32/46 subjects) of surveys were conducted in English, while 30.4% (14/46 subjects) were conducted in Spanish (Table 1).

Six different oral sedation drug regimens were employed: 45.6% (21/46 subjects) received morphine, midazolam, and hydroxyzine; 28.3% (13/46 subjects) received morphine, diazepam, and hydroxyzine; 15.2% (7/46 subjects) received chloral hydrate, meperidine, and hydroxyzine; 6.5% (3/46 subjects) received morphine and hydroxyzine; 2.2% (1/46 subjects) received meperidine, midazolam, and hydroxyzine; and 2.2% (1/46 subjects) received midazolam alone (Table 2, Figure 1). The study's population pool did not exhibit enough statistical power to compare different sedation regimens.

Resident doctors assessed each patient's presedation cooperation level: 6.5% (3/46 subjects) were unable/unwilling to cooperate, 2.2% (1/46 subjects) rarely followed requests, 52.2% (24/46 subjects) cooperated with prompting, and 41.3% (19/46 subjects) cooperated

Table 1. Patient Demographics

	n (%)
Gender	
Boy	50
Girl	50
Language survey was conducted	
English	69.6
Spanish	30.4
Age	
<4 years	17.3
4–6 years	47.8
>6 years	34.8
Medical history	
ASA I	73.9
ASA II	26.1
Takes medication	17.4
Exhibits allergies	8.7
Ethnicity	
Hispanic or Latino	80.5
Black or African American	6.5
White, non-Hispanic	4.3
Asian	4.3
Unknown	4.3

freely. In regards to patient presedation interaction levels, 15.2% (7/46 subjects) were definitively shy and withdrawn, 43.5% (20/46 subjects) were somewhat shy, and 41.3% (19/46 subjects) were approachable. Finally, 69.6% (32/46 subjects) of patients took the oral medication regimen willingly, 13.0% (6/46 subjects) were given the medication by his/her caregiver, and 17.4% (8/46 subjects) needed the medication to be syringed into the mouth by the clinician (Table 3).

Following completion of the dental treatment, resident doctors reported the following sedation levels: 13.0% (6/46 subjects) exhibited a typical response/cooperation and no sedation, 28.3% (13/46 subjects) exhibited a minimal sedation characterized by anxiolysis, 56.5% (26/46 subjects) exhibited a moderate sedation level characterized by a purposeful response to verbal commands with or without light tactile sensation, 28.3% (13/46 subjects) exhibited a deep sedation level characterized by a purposeful response after repeated verbal or painful stimulation, and none were not able to be aroused. 23.9% (11/46 subjects) of sedations were deemed ineffective, 37.0% (17/46 subjects) effective, 37.0% (17/46 subjects) very effective, and 2.2% (1/46 subjects) overly sedated (Table 3).

60.1% (28/46 subjects) of patients slept in the car on the way home. Moreover, 21.4% (6/28 subjects) of that group was noted to be difficult to awaken upon reaching home. On a typical day, 39.1% (18/46 subjects) of patients normally nap at home; however, following sedation, 76.1% (35/46 subjects) of patients slept after the appointment. Out of those who slept at home

Table 2. Oral Sedation Regimens

	n/n (%)
Morphine, midazolam, and hydroxyzine	21/46 subjects (45.6)
Morphine, diazepam, and hydroxyzine	13/46 subjects (28.3)
Morphine and hydroxyzine	3/46 subjects (6.5)
Meperidine, midazolam, and hydroxyzine	1/46 subjects (2.2)
Chloral hydrate, meperidine, and hydroxyzine	7/46 subjects (15.2)
Midazolam alone	1/46 subjects (2.2)

following the dental visit, 65.2% (30/46 subjects) napped longer than usual. After the appointment, 19.6% (9/46 subjects) exhibited nausea and 55.6% (5/9 subjects) of these patients vomited. 7.0% (3/46 subjects) experienced a fever (Table 4). The time to a return to normal behavior and routine was reported by caretakers as follows: 17.4% (8/46 subjects) in <2 hours, 39.1% (18/46 subjects) in 2–6 hours, 28.3% (13/46 subjects) in 6–10 hours, and 15.2% (7/46 subjects) in >10 hours (Figure 2).

Although caretakers were advised that they would be contacted within 24 hours following discharge time, it was

Table 3. Presedation Behavior and Sedation Effectiveness

	n/n (%)
Presedation cooperation	
Unable/unwilling to cooperate	3/46 (6.5)
Rarely followed requests	1/46 (2.2)
Cooperated with prompting	24/46 (52.2)
Cooperated freely	19/46 (41.3)
Presedation interaction	
Definitively shy and withdrawn	7/46 (15.2)
Somewhat shy	20/46 (43.5)
Approachable	19/46 (41.3)
Delivery of oral medications	
Willingly by him/herself	32/46 (69.6)
By caregiver	6/46 (13.0)
Syringed by clinician	8/46 (17.4)
Sedation level	
Typical response	6/46 (13.0)
Mild sedation	13/46 (28.3)
Moderate sedation	26/46 (56.5)
Deep sedation	13/46 (28.3)
Effectiveness of sedation	
Ineffective	11/46 (23.9)
Effective	17/46 (37.0)
Very Effective	17/46 (37.0)
Overly Sedated	1/46 (2.2)
Responsiveness to treatment	
Excellent	16/46 (34.7)
Good	9/46 (19.6)
Fair	9/46 (19.6)
Poor	3/46 (6.5)
Prohibitive	9/46 (19.6)

Table 4. Postsedation Adverse Events

	n/n (%)
Slept on the way home	28/46 (60.1)
Difficult to awaken upon reaching home	6/28 (21.4)
Nap at home on a typical day	18/46 (39.1)
Napped at home	35/46 (76.1)
Napped more than usual	30/46 (65.2)
Breathing difficulty	1/46 (2.2)
Problems with eating	7/46 (15.2)
Nausea	9/46 (19.6)
Vomiting	5/9 (55.6)
Diarrhea	1/46 (2.2)
Constipation*	1/22 (4.5)
Altered cognitive function*	7/22 (31.2)
Fever	3/46 (7.0)

* Not all subjects were asked the pertaining question.

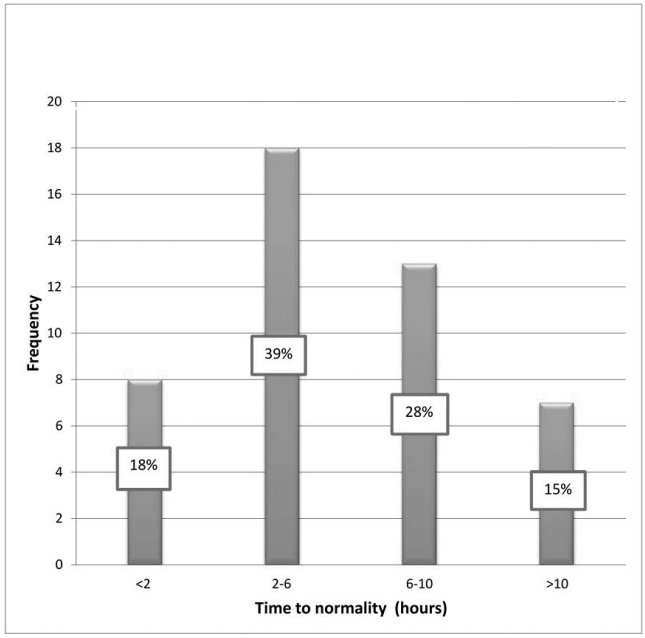

Figure 2. Frequency of time to return to normal behavior and routine.

difficult to reach the majority of caretakers successfully within the 24-hour time frame. Half of the subjects were contacted within 48 hours; however, the successful time of contact of the study's subjects ranged up to 11 days: 28.3% (13/46 subjects) were reached within 24 hours, 21.7% (10/46 subjects) were reached with 48 hours, and 50.0% (23/46 subjects) were reached after 48 hours. However, time of contact with the caregiver was not found to be a confounding factor. Postsedation adverse events data were also stratified for age, gender, language used during survey, and medical status (ASA I vs ASA II). None were found to be confounding factors.

The data were analyzed to compare the 3 presedation variables (ie, method of delivery of sedative medication, degree of presedation interaction and level of presedation cooperation) with the 3 sedation outcomes (ie, level of sedation, response to sedation, and sedation efficacy) via Fisher exact tests.

1. Comparison of sedation level versus 3 presedation factors and behaviors (Figure 3).
   a. Method of medication delivery and sedation level was found to be significantly associated ($P = .02$). A higher proportion of patients who took the medication willingly by him/herself often reached a moderate level of sedation compared to those who needed the medication to be syringed into the mouth by the operator or the caregiver.
   b. Type of presedation interaction and sedation level were found to approach statistical significance ($P = .07$). Patients who exhibited a more approachable presedation interaction were more likely to achieve a moderate level of sedation.
   c. No significant relationship between the level of presedation cooperation and sedation level was found; however, a general pattern was observed between a positive presedation cooperation (ie, cooperates freely and with prompting) and the child reaching a more moderate (deeper) level of sedation.
2. Comparison of response to treatment versus presedation factors and behaviors (Figure 4).
   a. No significant relationships were found between presedation factors and responsiveness to treatment. However, a general pattern of the child's positive presedation behavior (ie, cooperates freely, approachable interaction, takes medication willingly) exhibiting a better response to treatment was observed.
3. Comparison of sedation efficacy versus presedation factors and behaviors (Figure 5).
   a. Method of medication delivery and sedation efficacy was found to be significantly associated with effective sedation ($P = .03$). A higher proportion of patients who took the medication willingly by him/herself more often exhibited a more effective sedation visit as rated by the operating resident compared to those who needed the medication to be syringed into the mouth by the operator or the caregiver.
   b. No significant relationships were observed between the presedation level of cooperation and presedation interaction with effectiveness of sedation. However, it was evident that general patterns of more positive presedation cooperation and interaction levels (ie, cooperates freely, approach-

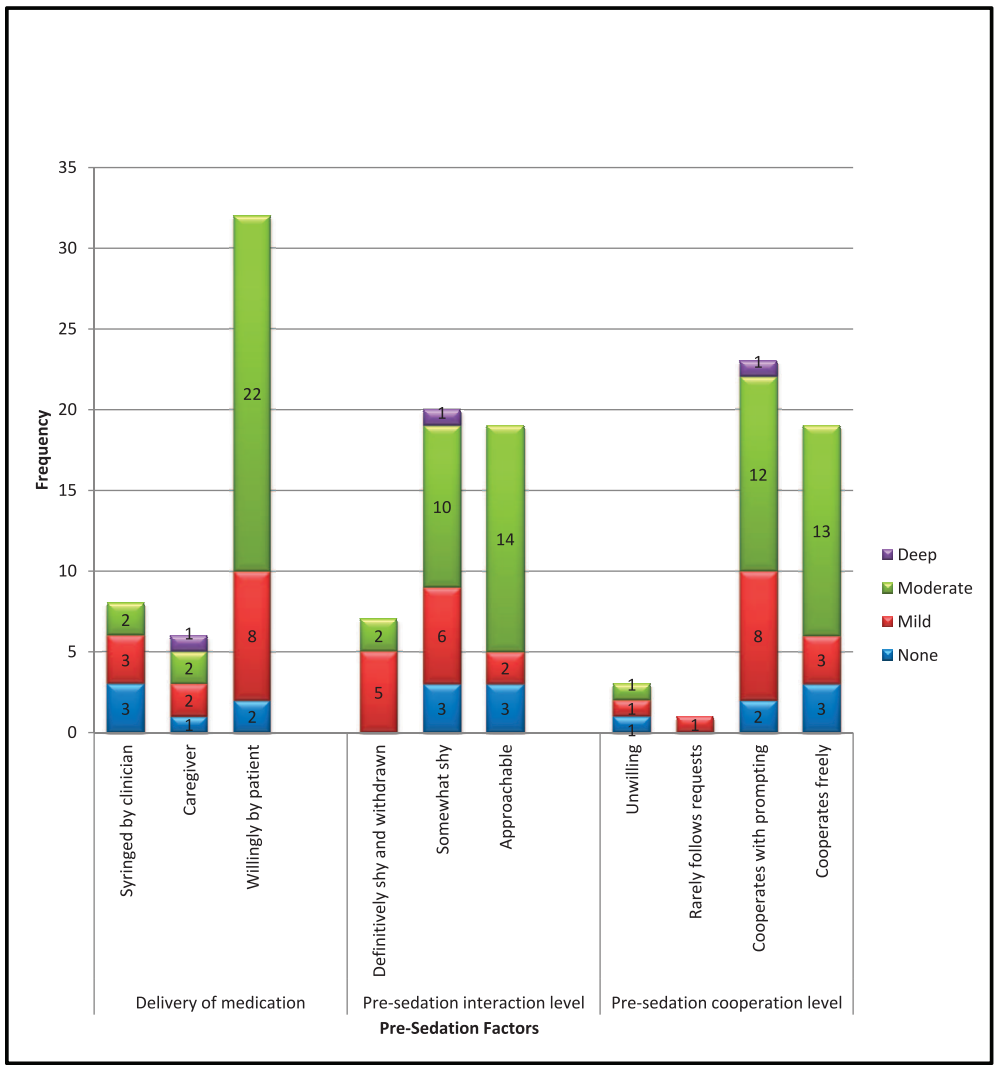

Figure 3. Comparison of sedation levels versus various presedation factors and behaviors.

able interaction) were associated with more effective sedations.

DISCUSSION

The results suggest that prolonged sedative effects and other adverse events are relatively common following oral sedation. This study found over half (60.1%) of patients slept on the way home and 21.4% of that group was noted to be difficult to awaken upon reaching home. Similarly, over half (65.2%) of patients also napped longer than usual while at home. As noted by Martinez and Wilson,[7] there is a concern for potential airway compromise with loss of airway reflexes and/or loss of the righting reflex of the head following oral sedation. Due to the utilization of multiple drug regimens, the sample sizes for each regimen were too small to allow for comparison. However, prolonged somnolence was demonstrated in a large percentage of the population similar to studies conducted with both oral sedation and general anesthesia.[6–8] A previous study involving oral sedation with high-dose chloral hydrate or midazolam reported postdischarge excessive somnolence in 41.9% of subjects, while the study performed with general anesthesia reported postdischarge somnolence to be 64%. Previous studies involving oral sedation did not utilize morphine while 80.4% of our subjects received morphine as part of their drug regimen. While the results of this study reported a high rate of excessive somnolence of 65.2% of patients following discharge, the plasma elimination half-life of morphine is 2–4 hours in children compared to the much longer 8–12 hours for chloral hydrate's active metabolite, trichlorethanol.[9–12] However, the coadministration of a benzodiazepine such as midazolam or diazepam with a narcotic may exert a synergistic effect. Regardless, the results emphasize the

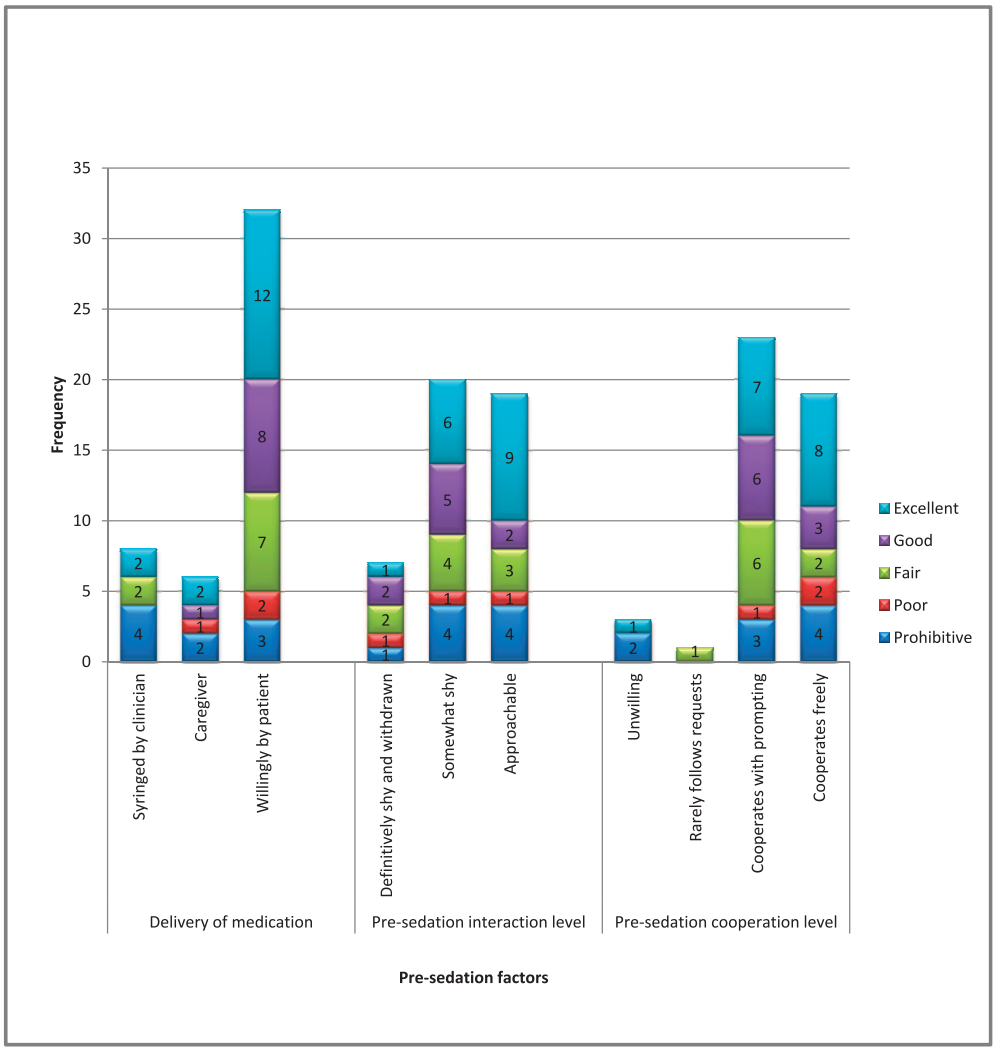

Figure 4. Comparison of responsiveness to treatment versus presedation factors and behaviors.

importance of adherence to discharge criteria of sedation guidelines and the delivery of clear postoperative instructions to caregivers by clinicians.

One caretaker noted their child's difficulty breathing was characterized by coughing much more than usual, but it was reported that there was no need for any medications or assistance. This particular patient exhibited asthma induced by weather changes and exercise and usually took albuterol and beclomethasone dipropionate when necessary. Overall, no major adverse sequelae associated with airway obstruction were reported during the follow-up phone call with caretakers; however, this finding demonstrates the importance of thorough preoperative screening and special postoperative precautions be taken for patients with respiratory disease such as asthma or reactive airway disease.

Mayeda and Wilson[6] reported 40% of children exhibited normal behavior within 6 hours following discharge from the Post Anesthesia Care Unit after general anesthesia, and 34% of patients took more than 12 hours. In this current study, over half of subjects (56.5%) reached their normal baseline behavior within 6 hours following oral sedation and 15.2% of subjects took longer than 10 hours according to caregivers. These results demonstrate that oral sedation can also produce a significantly prolonged recovery time.

Nausea was seen in 19.6% of patients and 55.6% of those with nausea exhibited episodes of emesis. This finding was not seen in previous studies; however, drug regimens used in this study were different and antiemetic medications may have been utilized in previous studies.[6,8] Altered cognitive function including dizziness (3 of 22), mood changes (3 of 22), or hallucinations (1 of 22) were noted in 7 of 22 patients (31.2%). This question for these 22 participants was included after the study had commenced, but the finding is nevertheless impressive

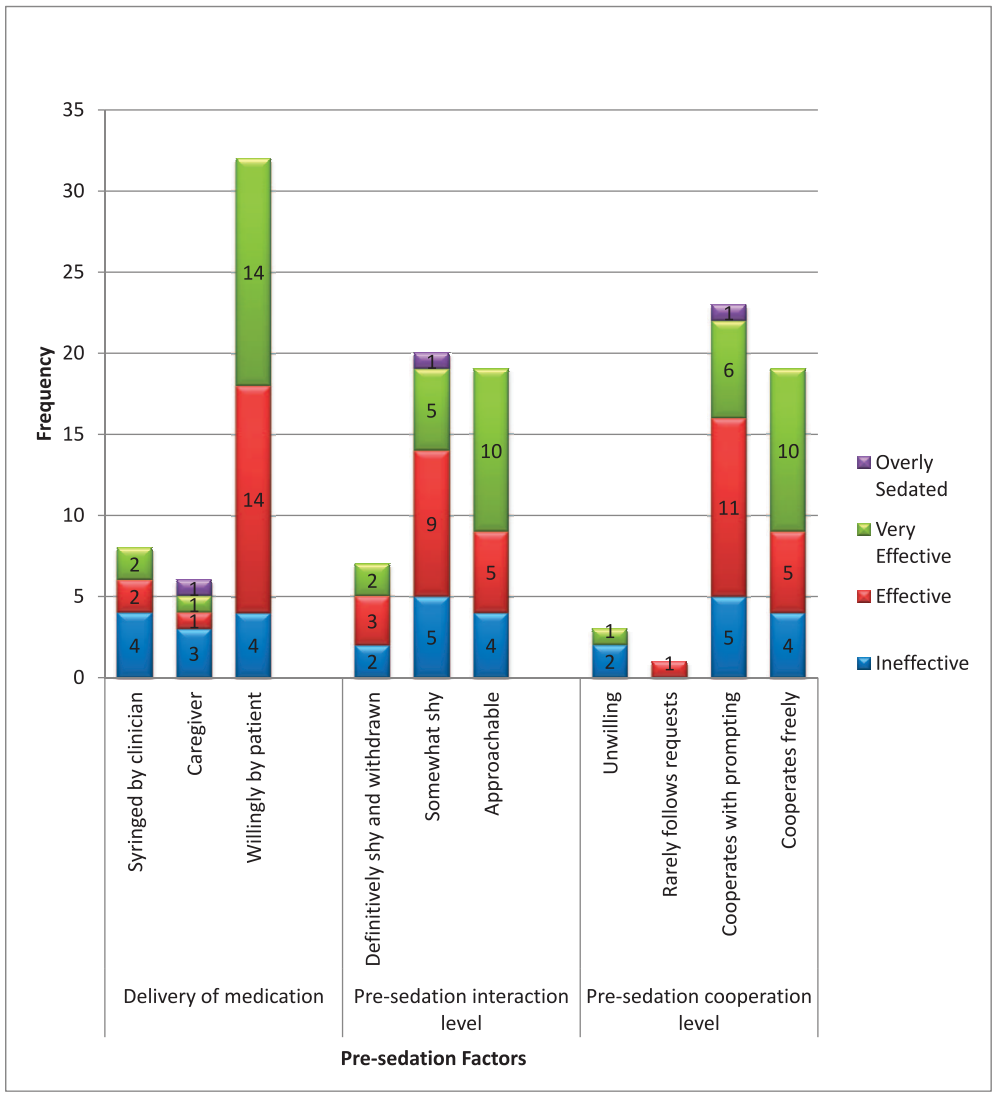

Figure 5. Comparison of sedation efficacy versus presedation factors and behaviors.

since poor balance and temper tantrums may lead to falls and injuries in children with altered cognitive function.

Comparison of the 3 presedation variables (ie, how sedative medication was administered, presedation cooperation, and presedation interaction) versus the 3 sedation outcomes (ie, level of sedation, response to sedation, and sedation efficacy) yielded 2 significant relationships: Patients who took the medication willingly by him/herself more often reached a moderate level of sedation than those who needed the medication to be syringed into the mouth by the resident doctor or to be administered by the caregiver ($P = .02$) (Figure 3). Patients who took the sedation medication willingly by him/herself more often exhibited a more effective sedation visit ($P = .03$) (Figure 5).

Although the other relationships were not found to be statistically significant, the results demonstrate general trends of children with more positive presedation behavior (ie, cooperates freely or with prompting, approachable interaction, takes medication willingly) exhibiting more effective and deeper levels of sedation.

Overall, resident doctors reported the majority (75.9%) of sedations to be fair, good, or excellent consistent with efficacy of oral sedation in previous studies (Table 3). Wilson et al[13] found that the majority of pediatric dentistry residency programs surveyed reported a 41–60% oral sedation success rate in their programs. Variable success rates have also been reported dependent on drug regimen. For example, Hasty et al[14] reported an operator-reported success rate of 100% for an oral sedation drug regimen involving hydroxyzine pamoate, chloral hydrate, and meperidine; while the drug regimen of hydroxyzine pamoate and chloral hydrate without meperidine produced a 30% success

rate. These findings support the importance of patient selection for oral sedation and presedation behavior to achieve a more effective sedation visit.

Limitations of this study need to be addressed. The data were completely reported by caretakers, so reporting bias may have occurred. Also, half of caretakers could not be reached within an ideal amount of time. The successful contact of the study's subjects ranged up to 11 days; however, 50% of caretakers were reached within 48 hours postdischarge. Furthermore, no significant difference was found between those who were contacted in less than 48 hours versus greater than 48 hours. It was also impossible to determine how much attention was given to the child during the postoperative period. Finally, because USCPD utilized multiple sedation drug regimens, a larger sample size would be needed in order to compare the different regimens.

CONCLUSIONS

Postdischarge excessive somnolence during transit and while at home, and to a lesser extent, nausea and emesis, were frequent complications with oral sedation utilizing our drug regimens. Recovery time to baseline status according to caregivers ranged from a few hours to the following morning. The findings of this study strongly support the importance of proper postoperative instructions to the patient's caregiver including possible complications and the necessity of careful vigilance of the child until recovery is complete.

REFERENCES

1. American Academy of Pediatrics; American Academy of Pediatric Dentistry. Guideline for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. *Pediatr Dent*. 2012–2013;34(6): 194–210.

2. Coté CJ, Karl HW, Notterman DA, Weinberg JA, McCloskey C. Adverse sedation events in pediatrics: analysis of medications used for sedation. *Pediatrics*. 2000;106:633–644.

3. Chicka, MC, Dembo JB, Mathu-Muju KR, Nash DA, Bush H. Adverse events during pediatric dental anesthesia and sedation: a review of closed malpractice insurance claims. *Pediatr Dent*. 2012;34(3):231–238.

4. Malviya S, Voepel-Lewis T, Prochaska G, Tait AR. Prolonged recovery and delayed side effects of sedation for diagnostic imaging studies in children. *Pediatrics*. 2000; 105(3):e42.

5. Malviya S, Voepel-Lewis T, Ludomirsky A, Marshall J, Tait AR. Can we improve the assessment of discharge readiness? A comparative study of observational and objective measures of depth of sedation in children. *Anesthesiology*. 2004;100:218–224.

6. Mayeda C, Wilson S. Complications within the first 24 hours after dental rehabilitation under general anesthesia. *Pediatr Dent*. 2009;31(7):513–519.

7. Martinez D, Wilson S. Children sedated for dental care: a pilot study of the 24-hour postsedation period. *Pediatr Dent*. 2006;28(3):260–264.

8. Costa LR, Costa PS, Brasileiro SV, Bendo CB, Viegas CM, Paiva SM. Post-discharge adverse events following pediatric sedation with high doses of oral medication. *J Pediatr*. 2012; 160(5):807–813.

9. Glare PA, Walsh TD. Clinical pharmacokinetics of morphine. *Ther Drug Monit*. 1991;13(1):1–23.

10. Kart T, Christrup L, Rasmussen M. Recommended use of morphine in neonates, infants and children based on a literature review: Part 1—Pharmacokinetics. *Pediatr Anesthesia*. 1997;7(1):5–11.

11. Mayers DJ, Hindmarsh KW, Sankaran K, Gorecki DK, Kasian GF. Chloral hydrate disposition following single-dose administration to critically ill neonates and children. *Develop Pharmacol Ther*. 1991;16(2):71–77.

12. Tobias JD, Leder M. Procedural sedation: a review of sedative agents, monitoring, and management of complication. *Saudi J Anaesthesia*. 2011;5:395–410.

13. Wilson S, Farrell K, Griffen A, Coury D. Conscious sedation experiences in graduate pediatric dentistry programs. *Pediatr Dent*. 2001;23(3):307–314.

14. Hasty MF, Vann WF, Dilley DC, Anderson JA. Conscious sedation of pediatric dental patients: an investigation of chloral hydrate, hydroxyzine pamoate, and meperidine vs. chloral hydrate and hydroxyzine. *Pediatr Dent*. 1991;13(1): 10–19.