Procedure Guideline for Pediatric Sedation in Nuclear Medicine

Gerald A. Mandell, Jeffrey A. Cooper, Massoud Majd, Eglal I. Shalaby-Rana and Isky Gordon
A.I. Dupont Institute, Wilmington, Delaware; Albany Medical Center, Albany, New York; Children's National Medical Center, Washington, D.C.; and Great Ormond Street Hospital for Children NHS Trust, London, England

Key Words: sedation; pediatrics; diagnostic imaging; practice guideline; life support
J Nucl Med 1997; 38:1640–1643

PART I: INTRODUCTION

The increasing complexity of pediatric nuclear medicine studies has led to a greater use of sedation. These recommendations for sedation of selected children undergoing nuclear medicine procedures are generated to provide assistance to those institutions without pediatric sedation guidelines already in place, and are not intended to replace satisfactory existing policies.

PART II: PUBLISHED RULES CONCERNING PEDIATRIC SEDATION

The Joint Commission on Accreditation of Health Care Organizations mandates an institution-wide policy for pediatric sedation. It is advisable to follow each institution's established sedation policy, if it exists. Guidelines for the monitoring and sedation of children are published by the American Academy of Pediatrics (AAP) (*1*). These guidelines are quite extensive and include documentation, informed consent, patient preparation, pre-sedation evaluation, monitoring, post-sedation care, discharge criteria and instructions as well as follow-up.

PART III: BENEFITS OF SEDATION

There are several uses of sedation in nuclear medicine. First, some procedures such as SPECT or high-resolution, pin-hole imaging require that the child remain absolutely still for extended periods of time. Sedation can reduce patient motion during these prolonged image acquisitions. Second, the use of sedation is to allow performance of a procedure that requires cooperation of an older child who refuses to cooperate for an exam. Typically, patients in this group have an exaggerated fear of the procedure because of a developmental disability, previous health care experiences or a traumatic experience such as physical or sexual abuse. Third, patient sedation can also enhance patient care by minimizing discomfort or pain. These recommendations provide suggestions on how to use sedation to maximize the quality of imaging procedures while minimizing the risks.

Received Jun. 17, 1997; accepted Jun. 17, 1997.
For correspondence or reprints contact: Wendy J.M. Smith, Director of Health Care Policy, 1850 Samuel Morse Dr., Reston, VA 20190-5316 or via e-mail at wsmith@snm.org.
Note: All 26 SNM-approved procedure guidelines are available on the Society's home page. We encourage you to download these documents via the Internet at http:\\www.snm.org. If you would like information on the development process of this guideline or to order a compendium of all 26 procedure guidelines for $20.00, please contact Wendy J.M. Smith, Society of Nuclear Medicine at (703) 708-9000, ext. 242 or via e-mail at wsmith@snm.org.

PART IV: RISKS OF SEDATION

The risks of sedation include hypoventilation, apnea, airway obstruction, cardiopulmonary arrest and the morbidity and mortality associated with these events. Appropriate personnel and equipment reduce the likelihood of such untoward events. The providers of sedation must be able to recognize these risks and rapidly respond with appropriate and effective treatment. The decision to sedate the child must involve a careful comparison of the risks and the benefits.

PART V: APPROPRIATE PERSONNEL AND EQUIPMENT

Safe sedation requires an appropriately trained individual (ATI) with experience and training in pediatric sedation, pediatric airway maintenance and Pediatric Advanced Life Support (PALS). The ATI, not only explains the sedation procedure to the family, but screens the child for negative outcome factors such as significant upper airway obstruction, apnea, reactive airway disease, risk for vomiting and aspiration, and uncontrolled seizures. A consultation with a pediatric anesthesiologist or intensivist about a child with risk factors may be necessary prior to the sedation procedure (see Addendum 1).

An emergency cart with equipment and drugs suitable for children of all ages and sizes should be readily available. Functioning suction apparatus with appropriate suction catheters as well as positive pressure oxygen delivery system, capable of administering greater than 90% oxygen, are also mandatory. The ATI continually monitors the patient with a pulse oximeter throughout the procedure. The patient is monitored until awakening and the institution's discharge criteria are met.

PART VI: DEFINITIONS

Sedation is a medically controlled state of depressed consciousness or unconsciousness. Sedation can be divided into conscious sedation, deep sedation and general anesthesia. In conscious sedation, the patient maintains the ability to respond to external stimulation. In deep sedation, patients are not easily aroused. In general anesthesia, patients are not arousable by stimulation.

The important clinical distinction between these states revolves around the ability of the patient to maintain their protective reflexes. Consciously sedated patients maintain their protective reflexes like gagging and swallowing and therefore can keep their airway patent without assistance. Deeply sedated patients may lose these reflexes and may not be able to maintain their airway. Patients under general anesthesia have lost their protective reflexes and are unable to maintain their airway.

There are no sharp boundaries between conscious sedation, deep sedation and general anesthesia. Furthermore, patients may rapidly move from conscious sedation through deep sedation to general anesthesia. Therefore, clinics that sedate children must be prepared to manage all levels of sedation and general anesthesia, even if only conscious sedation is intended.

PART VII: AVOIDANCE OF SEDATION

For many pediatric nuclear procedures, sedation and its attendant risks are avoidable by having an attentive and caring approach to children.

The pain of most nuclear medicine procedures is limited to a single venipuncture or catheterization of the bladder. For patients in whom the pain of venipuncture is a limiting factor, topical lidocaine preparations are available. These are best used 1–2 hr before injection. They may be prescribed before the procedure and applied by a parent at home before arriving in the nuclear medicine clinic. Xylocaine jelly can be used for difficult urethral catheterizations (particularly in males).

Many non-pharmacologic strategies are available to help the child cooperate and hold still during a nuclear medicine exam. Cooperation can be maximized in many instances by allowing the parents to be with their child during the examination and letting the child have the comfort of a pacifier, a bottle, a blanket or a stuffed animal. Depending on the age of the child, a reassuring description of the procedure can be provided before and during the procedure by a technologist who has good rapport with children. The room can be decorated to make it more interesting and comfortable to the child. The distraction of a child's attention by reading of a story, television and VCR allows reduction of patient motion. Parents are instructed to schedule the procedure during the younger child's nap time to maximize the chances that he/she will sleep during the procedure. In addition, a "papoose," sandbags or adhesive tape can be used to restrain infants and younger children. Use of the above strategies can avoid sedation while allowing acquisition of quality images.

PART VIII: CHOOSING A SEDATION REGIMEN

Sedation regimens vary greatly from one institution to another and even among physicians in the same department. There is no consensus on the best protocol for the sedation of children (*2*). The choice of drugs and route of administration depends on the patient's age, history of underlying illness (e.g., mental deficiency, cardiac or respiratory illness), experience and familiarity with certain drugs, institutional protocols, length of procedure and availability of support (reversal drugs).

In infants and young children, rectally, or more commonly, orally administered drugs are adequate for sedation. Rectal absorption tends to be erratic and the oral method is usually the preferred route of administration. Chloral hydrate is commonly used in infants and young children (usually <10–15 kg) and is recommended by the AAP as an "effective sedative with a low incidence of acute toxicity when administered orally in the recommended dosage for short-term sedation" (*3*). Chloral hydrate in a dose of 50–70 mg/kg (maximum total accumulated dose of 100 mg/kg) is usually adequate to achieve sedation. The maximum total dose varies according to the guidelines of the individual institution (*4*). Often in older, larger or mentally deficient children chloral hydrate doesn't suffice as the only sedation and additional medication may have to be added to the sedation regimen (*5*).

In older patients and children with mental deficiency, parenteral sedation, usually intravenous, may be the preferred method. Intravenous sedation allows for rapid induction and recovery with better scheduling of sedation cases during high volume periods. However, intravenous sedation must be titrated for each patient using the recommended dosage range.

Pentobarbital sodium (Nembutal) is popular because it is a short-acting barbiturate with low incidence of respiratory depression. It is commonly used in dosages of 2–6 mg/kg. The maximum dosage varies according to the guidelines of the individual institution (*6,7*). Nembutal is contradicted in patients with porphyria and may require higher doses in patients being treated for a seizure disorder. Other intravenous sedation regimens (opiates and benzodiazepines) are used less frequently in the pediatric population. Reversal drugs are required to treat overdoses, such as nalozone (Narcan) for opiates and flumazenil (Romazicon) for benzodiazepines.

Classes of drugs used for parenteral sedation. Dosages vary and can be generated by the pediatric anesthesiology or critical care section of the individual institution.

- Barbiturates including pentobarbital sodium (Nembutal).
- Opiates including meperidine (Demerol) and fentanyl (Sublimaze).
- Benzodiazepines including diazepam (Valium) and midazolam (Versed).
- Phenothiazines including chlorpromazine (Thorazine) and Promethazine (Phenergan).
- Neuroleptic agents including ketamine (Ketalar).

Sedation protocols use drugs singly or in combination. The use of analgesic opiates such as fentanyl and meperidine (as part of DPT, Demerol, Phenergan and Thorazine) is rarely necessary for most nuclear medicine procedures. Also, opiates may cause respiratory depression, especially if administered rapidly. Ketamine can cause hallucinations in older children.

Midazolam can also be used as an adjunct with other sedation drugs such as opiates and barbiturates, and may be used orally, intravenously, rectally (*6–11*) or intranasally. Recently, there is a growing enthusiasm for the use of intranasal midazolam with its predominantly amnesic effect in children undergoing preanesthetic sedation, echo cardiography, and short surgical procedures (*12–13*). Nasally administered midazolam has been shown to have very minimal respiratory depression and a relatively short duration of sedation, approximately 35–45 min. It obviates the need for i.v. access and may be suited for some nuclear medicine procedures. The exact dosages and preferred routes of administration should be ascertained from the guidelines of the individual institution.

The nuclear medicine physician should consult with the anesthesiology department in each institution for specific recommendations on dosages and combinations of sedative drugs. Consultation with an anesthesiologist is particularly important in patients with a history of significant snoring, abnormal airway (i.e., micrognathia), congenital heart disease, reactive airways disease and increased intracranial pressure (*14*).

PART IX: DEVELOPING A SEDATION POLICY

A written pediatric sedation policy is strongly recommended. The policy should follow institution-wide policy for pediatric sedation and also follow the guidelines of the American Academy of Pediatrics. Many institutions have sedation committees with representation from anesthesiology, nursing, intensive care, pediatrics and pediatric imaging. This committee can serve as a source of information for the development of the sedation policy in nuclear medicine.

Written medication protocols for sedation are also strongly recommended. There are many sedation protocols available for pediatric sedation, not all of which are appropriate for nuclear imaging procedures. The exact protocol or set of protocols should be tailored to the age of the patient, the pain or discomfort level of the procedure, the length of the imaging procedure, and most importantly, the experience of physicians in each clinic. The best source of specific sedation protocols is likely to be the institution's anesthesiologist or intensivist, or preferably, pediatric anesthesiologist or pediatric intensivist.

These individuals should have the greatest experience in sedation and should know the latest information on various sedation methods.

The American Academy of Pediatrics recommends that parents give written informed consent according to each institution's protocol. Consultation with the institution's legal counsel may be helpful to determine guidelines for obtaining such consent.

PART X: DISCLAIMER

The Society of Nuclear Medicine has written and approved guidelines to promote the cost-effective use of high quality nuclear medicine procedures. These generic recommendations cannot be applied to all patients in all practice settings. The guidelines should not be deemed inclusive of all proper procedures or exclusive of other procedures reasonably directed to obtaining the same results. The spectrum of patients seen in a specialized practice setting may be quite different than the spectrum of patients seen in a more general practice setting. The appropriateness of a procedure will depend in part on the prevalence of disease in the patient population. In addition, the resources available to care for patients may vary greatly from one medical facility to another. For these reasons, guidelines cannot be rigidly applied.

Advances in medicine occur at a rapid rate. The date of a guideline should always be considered in determining its current applicability.

PART XI: ISSUES REQUIRING FURTHER CLARIFICATION

None

PART XII: CONCISE BIBLIOGRAPHY

1. American Academy of Pediatrics Committee on Drugs. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. *Pediatrics* 1992;89:1110–1115.
2. Keeter S, Benator RM, Weinberg SM, et al. Sedation in pediatric CT: national survey of current practice. *Radiology* 1990;175:745–752.
3. American Academy of Pediatrics Committee on Drugs and Committee on Environmental Health. Use of chloral hydrate for sedation in children. *Pediatrics* 1993;92: 471–473.
4. Greenberg SB, Faerber EN, Aspinall CL, et al. High-dose sedation for children undergoing MR imaging: safety and efficacy in relation to age. *AJR* 1993;161: 639–641.
5. Greenberg SB, Faerber EN, Radke JL, et al. Sedation of difficult-to-sedate children undergoing MR imaging: value of thioridazine as an adjunct to chloral hydrate. *AJR* 1994;163:165–168.
6. Strain JD, Harvey LA, Foley LC, et al. Intravenously administered pentobarbital sodium for sedation in pediatric CT. *Radiology* 1986;161:105–108.
7. Strain JD, Campbell JB, Harvey LA, et al. IV Nembutal: safe sedation for children undergoing CT. *AJR* 1988;151: 975–979.
8. Pereira JK, Burrows PE, Richards HM, et al. Comparison of sedation regimens for pediatric outpatient CT. *Pediatr Radiol* 1993;23:341–344.
9. Diament MJ, Stanley P. The use of midazolam for sedation of infants and children. *AJR* 1988;150:377–378.
10. Burrows PE. Pediatric sedation for nuclear medicine procedures. In: Treves ST, ed. *Pediatric nuclear medicine* 2nd ed. New York: Springer-Verlag; 1995:12–16.
11. Snodgrass WR, Dodge WF. Lytic/DPT cocktail: time for rational and safe alternatives. *Ped Clin of N Am* 1989; 36:1285–1291.
12. Adrian ER. Intranasal versed: the future of pediatric conscious sedation. *Pediatr Nurs* 1994;20:287–292.
13. Latson LA, Cheatham JP, Gumbiner CH, et al. Midazolam nose drops for outpatient echocardiography sedation in infants. *Am Heart J* 1991;121:209–210.
14. Louon A, Reddy VG. Nasal midazolam and ketamine for paediatric sedation during computerised tomography. *Acta Anaesthesiol Scand* 1994;38:259–261.

PART XIII: LAST HOUSE OF DELEGATES APPROVAL DATE

June 2, 1996

PART XIV: NEXT ANTICIPATED APPROVAL DATE

1998

ACKNOWLEDGMENTS

Henry D. Royal, MD, chair of the Guidelines and Communications Committee, Commission on Health Care Policy and Practice, for overall coordination and oversight of the SNM Guideline Development Project; Wendy Smith, MPH, Director of Health Care Policy, Society of Nuclear Medicine, for project coordination, data collection and editing; members of the Pediatric Imaging Council and members of the Guideline Development Subcommittee: Helena Balon, MD, Stephen Bartold, MD, Howard Dworkin, MD, Bennett Greenspan, MD, and Henry Royal, MD who contributed their time and expertise to the development of this information.