Complete Summary

GUIDELINE TITLE

Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: an update.

BIBLIOGRAPHIC SOURCE(S)

American Academy of Pediatrics, American Academy of Pediatric Dentistry, Cote CJ, Wilson S, Work Group on Sedation. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: an update. Pediatrics 2006 Dec;118(6):2587-602. [213 references] PubMed

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: American Academy of Pediatrics (AAP). Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. Pediatrics 1992 Jun;89(6 Pt 1):1110-5.

Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: addendum. Pediatrics 2002 Oct;110(4):836-8.

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COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Conditions requiring elective and emergency use of sedative agents in nontraditional settings

GUIDELINE CATEGORY

Evaluation
Management

CLINICAL SPECIALTY

Anesthesiology
Dentistry
Pediatrics

INTENDED USERS

Dentists
Physicians

GUIDELINE OBJECTIVE(S)

To unify the guidelines for sedation used by medical and dental practitioners, add clarifications regarding monitoring modalities, provide new information from medical and dental literature, and suggest methods for further improvement in safety and outcomes

TARGET POPULATION

Pediatric patients undergoing elective and emergency procedures requiring the use of sedative and general anesthetic agents in any surgical setting

INTERVENTIONS AND PRACTICES CONSIDERED

Monitoring and documentation performed during and after a procedure for children receiving sedatives and general anesthetic agents

MAJOR OUTCOMES CONSIDERED

Morbidity and mortality associated with the use of sedative and general anesthetic agents in the nontraditional surgical setting

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Not stated

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Not stated

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

General Guidelines

Candidates

Patients who are in American Society of Anesthesiologists (ASA) classes I and II (see Appendix 1 in the original guideline document) are frequently considered appropriate candidates for minimal, moderate, or deep sedation. Children in ASA classes III and IV, children with special needs, and those with anatomic airway abnormalities or extreme tonsillar hypertrophy present issues that require additional and individual consideration, particularly for moderate and deep sedation (Malviya, Voepel-Lewis, & Tait, 1997). Practitioners are encouraged to consult with appropriate subspecialists and/or an anesthesiologist for patients at increased risk of experiencing adverse sedation events because of their underlying medical/ surgical conditions.

Responsible Person

The pediatric patient shall be accompanied to and from the treatment facility by a parent, legal guardian, or other responsible person. It is preferable to have 2 or more adults accompany children who are still in car safety seats if transportation to and from a treatment facility is provided by one of the adults (Bull et al., 1999).

Facilities

The practitioner who uses sedation must have immediately available facilities, personnel, and equipment to manage emergency and rescue situations. The most common serious complications of sedation involve compromise of the airway or depressed respirations resulting in airway obstruction, hypoventilation, hypoxemia, and apnea. Hypotension and cardiopulmonary arrest may occur, usually from inadequate recognition and treatment of respiratory compromise. Other rare complications may also include seizures and allergic reactions. Facilities that provide pediatric sedation should monitor for, and be prepared to treat, such complications.

Back-up Emergency Services

A protocol for access to back-up emergency services shall be clearly identified with an outline of the procedures necessary for immediate use. For nonhospital facilities, a protocol for ready access to ambulance service and immediate activation of the Emergency Medical Services (EMS) system for life-threatening complications must be established and maintained. It should be understood that the availability of EMS services does not replace the practitioner's responsibility to provide initial rescue in managing life-threatening complications.

On-Site Monitoring and Rescue Equipment

An emergency cart or kit must be immediately accessible. This cart or kit must contain equipment to provide the necessary age- and size-appropriate drugs and equipment to resuscitate a nonbreathing and unconscious child. The contents of the kit must allow for the provision of continuous life support while the patient is being transported to a medical facility or to another area within a medical facility. All equipment and drugs must be checked and maintained on a scheduled basis (see Appendices 3 and 4 in the original guideline document for suggested drugs and emergency life support equipment to consider before the need for rescue occurs). Monitoring devices, such as electrocardiography (ECG) machines, pulse oximeters (with size appropriate oximeter probes), end-tidal carbon dioxide monitors, and defibrillators (with size-appropriate defibrillator paddles), must have a safety and function check on a regular basis as required by local or state regulation.

Documentation

Documentation before sedation shall include, but not be limited to, the guidelines that follow.

1. Informed consent: the patient record shall document that appropriate informed consent was obtained according to local, state, and institutional requirements ("Informed consent," 1995)
2. Instructions and information provided to the responsible person: the practitioner shall provide verbal and/or written instructions to the responsible person. Information shall include objectives of the sedation and anticipated changes in behavior during and after sedation. Special instructions shall be given to the responsible adult for infants and toddlers who will be transported home in a car safety seat regarding the need to carefully observe the child's head position to avoid airway obstruction. Transportation in a car safety seat poses a particular risk for infants who have received medications known to have a long half-life, such as chloral hydrate, intramuscular pentobarbital, or phenothiazine (Cote, Karl, et al., 2000; Cote, Notterman, et al., 2000; Malviya et al., 2004; Malviya et al., "Prolonged recovery," 2000). Consideration for a longer period of observation shall be given if the responsible person's ability to observe the child is limited (e.g., only 1 adult who also has to drive). Another indication for prolonged observation would be a child with an anatomic airway problem or a severe underlying medical condition. A 24-hour telephone number for the practitioner or his or her associates shall be provided to all patients and their families. Instructions shall include limitations of activities and appropriate dietary precautions.

Dietary Precautions

Agents used for sedation have the potential to impair protective airway reflexes, particularly during deep sedation. Although a rare occurrence, pulmonary aspiration may occur if the child regurgitates and cannot protect his or her airway. Therefore, it is prudent that, before sedation, the practitioner evaluate preceding food and fluid intake. It is likely that the risk of aspiration during procedural sedation differs from that during general anesthesia involving tracheal intubation or other airway manipulation (Babl et al., 2005; Roback et al., 2004). However, because the absolute risk of aspiration during procedural sedation is not yet known, guidelines for fasting periods before elective sedation should generally

follow those used for elective general anesthesia. For emergency procedures in children who have not fasted, the risks of sedation and the possibility of aspiration must be balanced against the benefits of performing the procedure promptly (see below). Additional research is needed to better elucidate the relationships between various fasting intervals and sedation complications.

Before Elective Sedation

Children receiving sedation for elective procedures should generally follow the same fasting guidelines as those for general anesthesia (see Table below titled "Appropriate Intake of Food and Liquids Before Elective Sedation"). It is permissible for routine necessary medications to be taken with a sip of water on the day of the procedure.

Table. Appropriate Intake of Food and Liquid Before Elective Sedation

Ingested Material	Minimum Fasting Period, hours
• Clear liquids: water, fruit juices without pulp, carbonated beverages, clear tea, black coffee	2
• Breast milk	4
• Infant formula	6
• Nonhuman milk: because nonhuman milk is similar to solids in gastric emptying time, the amount ingested must be considered when determining an appropriate fasting period	6
• Light meal: a light meal typically consists of toast and clear liquids. Meals that include fried or fatty foods or meat may prolong gastric emptying time; both the amount and type of foods ingested must be considered when determining an appropriate fasting period	6

Before Emergency Sedation

The practitioner must always balance the possible risks of sedating nonfasted patients with the benefits and necessity for completing the procedure. In this circumstance, the use of sedation must be preceded by an evaluation of food and fluid intake. There are few published studies with adequate statistical power to provide guidance to the practitioner regarding safety or risk of pulmonary aspiration of gastric contents during procedural sedation (Babl et al., 2005; Roback et al., 2004; Agrawal et al., 2003; Green, 2003; Green & Krauss, 2002; Treston, 2004). When protective airway reflexes are lost, gastric contents may be regurgitated into the airway. Therefore, patients with a history of recent oral intake or with other known risk factors, such as trauma, decreased level of consciousness, extreme obesity, pregnancy, or bowel motility dysfunction, require careful evaluation before administration of sedatives. When proper fasting has not

been ensured, the increased risks of sedation must be carefully weighed against its benefits, and the lightest effective sedation should be used. The use of agents with less risk of depressing protective airway reflexes may be preferred (Green & Krauss, 2004). Some emergency patients requiring deep sedation may require protection of the airway before sedation.

Use of Immobilization Devices

Immobilization devices such as papoose boards must be applied in such a way as to avoid airway obstruction or chest restriction. The child's head position and respiratory excursions should be checked frequently to ensure airway patency. If an immobilization device is used, a hand or foot should be kept exposed, and the child should never be left unattended. If sedating medications are administered in conjunction with an immobilization device, monitoring must be used at a level consistent with the level of sedation achieved.

Documentation at the Time of Sedation

1. Health evaluation: before sedation, a health evaluation shall be performed by an appropriately licensed practitioner and reviewed by the sedation team at the time of treatment for possible interval changes. The purpose of this evaluation is to not only document baseline status but also determine if patients present specific risk factors that may warrant additional consultation before sedation. This evaluation will also screen out patients whose sedation will require more advanced airway or cardiovascular management skills or alterations in the doses or types of medications used for procedural sedation.

   A new concern for the practitioner is the widespread use of medications that may interfere with drug absorption or metabolism and, therefore, enhance or shorten the effect time of sedating medications. Herbal medicines (e.g., St John's wort or echinacea) may alter drug pharmacokinetics through inhibition of the cytochrome P450 system, resulting in prolonged drug effect and altered (increased or decreased) blood drug concentrations (Gorski et al., 2004; Hall et al., 2003; Markowitz et al., 2003; Spinella, 2001; Wang et al., 2001; Xie & Kim, 2005). Kava may increase the effects of sedatives by potentiating gamma-aminobutyric acid inhibitory neurotransmission, and valerian may itself produce sedation that apparently is mediated through modulation of gamma-aminobutyric acid neurotransmission and receptor function (Ang-Lee, Moss, & Yuan, 2001; Abebe, 2002). Drugs such as erythromycin, cimetidine, and others may also inhibit the cytochrome P450 system, resulting in prolonged sedation with midazolam as well as other medications competing for the same enzyme systems (von Rosensteil & Adam, 1995; Hiller et al., 1990; Mattila et al., 1993; Olkkola et al., 1993). Medications used to treat human immunodeficiency virus (HIV) infection, some anticonvulsants, and some psychotropic medications may also produce clinically important drug-drug interactions (Flockhart & Oesterheld, 2000; Yuan, Flockhart, & Balian, 1999; Young, 2005). Therefore, carefully obtaining a drug history is a vital part of the safe sedation of children. The clinician should consult various sources (a pharmacist, textbooks, online services, or handheld databases) for specific information on drug interactions (Wilkinson, 2005).

   The health evaluation should include:

- Obtaining age and weight
- Obtaining a health history, including (1) allergies and previous allergic or adverse drug reactions; (2) medication/drug history, including dosage, time, route, and site of administration for prescription, over-the-counter, herbal, or illicit drugs; (3) relevant diseases, physical abnormalities, and neurologic impairment that might increase the potential for airway obstruction, such as a history of snoring or obstructive sleep apnea (American Academy of Pediatrics, Subcommittee on Obstructive Sleep Apnea Syndrome & Section on Pediatric Pulmonology, 2002; Schechter, 2002); (4) pregnancy status; (5) a summary of previous relevant hospitalizations; (6) history of sedation or general anesthesia and any complications or unexpected responses; and (7) relevant family history, particularly that related to anesthesia
- A review of systems with a special focus on abnormalities of cardiac, pulmonary, renal, or hepatic function that might alter the child's expected responses to sedating/analgesic medications
- Determination of vital signs, including heart rate, blood pressure, respiratory rate, and temperature (for some children who are very upset or noncooperative, this may not be possible, and a note should be written to document this occurrence)
- A physical examination, including a focused evaluation of the airway (tonsillar hypertrophy, abnormal anatomy [e.g., mandibular hypoplasia]) to determine if there is an increased risk of airway obstruction (Hoffman et al., 2002; Litman et al., "Upper airway obstruction," 1998; Fishbaugh et al., 1997).
- A physical status evaluation (ASA classification [see Appendix 1 in the original guideline document])
- Obtaining name, address, and telephone number of the child's medical home

For hospitalized patients, the current hospital record may suffice for adequate documentation of presedation health; however, a brief note shall be written documenting that the chart was reviewed, positive findings were noted, and a management plan was formulated. If the clinical or emergency condition of the patient precludes acquiring complete information before sedation, this health evaluation should be obtained as soon as is feasible.

2. Prescriptions: when prescriptions are used for sedation, a copy of the prescription or a note describing the content of the prescription should be in the patient's chart along with a description of the instructions that were given to the responsible person. *Prescription medications intended to accomplish procedural sedation must not be administered without the benefit of direct supervision by trained medical personnel*. Administration of sedating medications at home poses an unacceptable risk, particularly for infants and preschool- aged children traveling in car safety seats (Cote, Notterman et al., 2000).

Documentation During Treatment

The patient's chart shall contain a time-based record that includes the name, route, site, time, dosage, and patient effect of administered drugs. Before

sedation, a "time out" should be performed to confirm the patient's name, procedure to be performed, and site of the procedure (Joint Commission on Accreditation of Healthcare Organizations, 2005). During administration, the inspired concentrations of oxygen and inhalation sedation agents and the duration of their administration shall be documented. Before drug administrations, special attention must be paid to calculation of dosage (i.e., mg/kg). The patient's chart shall contain documentation at the time of treatment that the patient's level of consciousness and responsiveness, heart rate, blood pressure, respiratory rate, and oxygen saturation were monitored until the patient attained predetermined discharge criteria (see Appendix 2 of the original guideline document). A variety of sedation-scoring systems are available and may aid this process (Malviya et al., 2002; Malviya et al., 2004). Adverse events and their treatment shall be documented.

Documentation After Treatment

The time and condition of the child at discharge from the treatment area or facility shall be documented; this should include documentation that the child's level of consciousness and oxygen saturation in room air have returned to a state that is safe for discharge by recognized criteria (see Appendix 2 in the original guideline document). Patients receiving supplemental oxygen before the procedure should have a similar oxygen need after the procedure. Because some sedation medications are known to have a long half-life and may delay a patient's complete return to baseline or pose the risk of resedation (Cote, Karl et al., 2000; Malviya et al., "Prolonged recovery," 2000; Mayers et al., 1991; Terndrup et al., 1991), some patients might benefit from a longer period of less-intense observation (e.g., a step-down observation area) before discharge from medical supervision (Cote, 2004). Several scales to evaluate recovery have been devised and validated (Malviya et al., 2002; Macnab et al., 1991; Chernik et al., 1990). A recently described and simple evaluation tool may be the ability of the infant or child to remain awake for at least 20 minutes when placed in a quiet environment (Malviya et al., 2004).

Continuous Quality Improvement

The essence of medical error reduction is a careful examination of index events and root-cause analysis of how the event could be avoided in the future (Bagian et al., 2001; May & Aulisio, 2001; Kazandjian, 2002; Connor, Ponte, & Conway, 2002; Gosbee, 2002). Therefore, each facility should maintain records that track adverse events such as desaturation, apnea, laryngospasm, the need for airway interventions including jaw thrust or positive pressure ventilation, prolonged sedation, unanticipated use of reversal agents, unintended or prolonged hospital admission, and unsatisfactory sedation/analgesia/anxiolysis. Such events can then be examined for assessment of risk reduction and improvement in patient satisfaction.

Preparation And Setup For Sedation Procedures

Part of the safety net of sedation is to use a systematic approach so as to not overlook having an important drug, piece of equipment, or monitor immediately available at the time of a developing emergency. To avoid this problem, it is helpful to use an acronym that allows the same setup and checklist for every

procedure. A commonly used acronym that is useful in planning and preparation for a procedure is SOAPME:

S (suction)—size-appropriate suction catheters and a functioning suction apparatus (e.g., Yankauer-type suction)

O (oxygen)—adequate oxygen supply and functioning flow meters/other devices to allow its delivery

A (airway)—size-appropriate airway equipment (nasopharyngeal and oropharyngeal airways, laryngoscope blades [checked and functioning], endotracheal tubes, stylets, face mask, bag-valve-mask or equivalent device [functioning])

P (pharmacy)—all the basic drugs needed to support life during an emergency, including antagonists as indicated

M (monitors)—functioning pulse oximeter with size-appropriate oximeter probes (Barker et al., 1993; Kelleher & Ruff, 1989) and other monitors as appropriate for the procedure (e.g., noninvasive blood pressure, end-tidal carbon dioxide, electrocardiogram [ECG], stethoscope)

E (equipment)—special equipment or drugs for a particular case (e.g., defibrillator)

Specific Guidelines For Intended Level of Sedation

Minimal Sedation

Minimal sedation (formerly anxiolysis) is a drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected. Children who have received minimal sedation generally will not require more than observation and intermittent assessment of their level of sedation. Some children will become moderately sedated despite the intended level of minimal sedation; should this occur, the guidelines for moderate sedation will apply (Dial et al., 2001).

Moderate Sedation

Moderate sedation (formerly conscious sedation or sedation/analgesia) is a drug-induced depression of consciousness during which patients respond purposefully to verbal commands or light tactile stimulation (see "Definition of Terms Used in This Report" in the original guideline document). No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained. The caveat that loss of consciousness should be unlikely is a particularly important aspect of the definition of moderate sedation. The drugs and techniques used should carry a margin of safety wide enough to render unintended loss of consciousness highly unlikely. Because the patient who receives moderate sedation may progress into a state of deep sedation and obtundation, the practitioner should be prepared to increase the level of vigilance corresponding to what is necessary for deep sedation (Dial et al., 2001).

Personnel

The Practitioner

The practitioner responsible for the treatment of the patient and/or the administration of drugs for sedation must be competent to use such techniques, provide the level of monitoring provided in these guidelines, and manage complications of these techniques (i.e., to be able to rescue the patient). Because the level of intended sedation may be exceeded, the practitioner must be sufficiently skilled to provide rescue should the child progress to a level of deep sedation. The practitioner must be trained in, and capable of providing, at the minimum, bag-valve-mask ventilation to be able to oxygenate a child who develops airway obstruction or apnea. Training in, and maintenance of, advanced pediatric airway skills is required; regular skills reinforcement is strongly encouraged.

Support Personnel

The use of moderate sedation shall include provision of a person, in addition to the practitioner, whose responsibility is to monitor appropriate physiologic parameters and to assist in any supportive or resuscitation measures if required. This individual may also be responsible for assisting with interruptible patient-related tasks of short duration (American Society of Anesthesiologists, 2002). This individual must be trained in and capable of providing pediatric basic life support. The support person shall have specific assignments in the event of an emergency and current knowledge of the emergency cart inventory. The practitioner and all ancillary personnel should participate in periodic reviews and practice drills of the facility's emergency protocol to ensure proper function of the equipment and coordination of staff roles in such emergencies.

Monitoring and Documentation

Baseline

Before administration of sedative medications, a baseline determination of vital signs shall be documented. For some children who are very upset or noncooperative, this may not be possible, and a note should be written to document this happenstance.

During the Procedure

The practitioner shall document the name, route, site, time of administration, and dosage of all drugs administered. There shall be continuous monitoring of oxygen saturation and heart rate and intermittent recording of respiratory rate and blood pressure; these should be recorded in a time-based record. Restraining devices should be checked to prevent airway obstruction or chest restriction. If a restraint device is used, a hand or foot should be kept exposed. The child's head position should be checked frequently to ensure airway patency. A functioning suction apparatus must be present.

After the Procedure

The child who has received moderate sedation must be observed in a suitably equipped recovery facility (i.e., the facility must have functioning suction apparatus as well as the capacity to deliver more than 90% oxygen and positive-pressure ventilation [e.g., bag and mask with oxygen capacity as described previously]). The patient's vital signs should be recorded at specific intervals. If the patient is not fully alert, oxygen saturation and heart rate monitoring shall be used continuously until appropriate discharge criteria are met (see Appendix 2 in the original guideline document). Because sedation medications with a long half-life may delay the patient's complete return to baseline or pose the risk of resedation, some patients might benefit from a longer period of less-intense observation (e.g., a stepdown observation area in which multiple patients can be observed simultaneously) before discharge from medical supervision (see also "Documentation" for instructions to families [Cote, Karl et al., 2000; Malviya et al., "Prolonged recovery," 2000; Mayers et al., 1991; Terndrup et al., 1991]). A recently described and simple evaluation tool may be the ability of the infant or child to remain awake for at least 20 minutes when placed in a quiet environment (Malviya et al., 2004). Patients who have received reversal agents, such as flumazenil or naloxone, will also require a longer period of observation, because the duration of the drugs administered may exceed the duration of the antagonist, which can lead to resedation.

Deep Sedation

Deep sedation is a drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully after repeated verbal or painful stimulation (see "Definition of Terms Used in This Report" in the original guideline document). The state and risks of deep sedation may be indistinguishable from those of general anesthesia.

Personnel

There must be 1 person available whose only responsibility is to constantly observe the patient's vital signs, airway patency, and adequacy of ventilation and to either administer drugs or direct their administration. At least 1 individual must be present who is trained in, and capable of, providing advanced pediatric life support and who is skilled in airway management and cardiopulmonary resuscitation; training in pediatric advanced life support is required.

Equipment

In addition to the equipment previously cited for moderate sedation, an ECG monitor and a defibrillator for use in pediatric patients should be readily available.

Vascular Access

Patients receiving deep sedation should have an intravenous line placed at the start of the procedure or have a person skilled in establishing vascular access in pediatric patients immediately available.

Monitoring

A competent individual shall observe the patient continuously. The monitoring shall include all parameters described for moderate sedation. Vital signs, including oxygen saturation and heart rate, must be documented at least every 5 minutes in a time-based record. The use of a precordial stethoscope or capnograph for patients who are difficult to observe (e.g., during magnetic resonance imaging (MRI) or in a darkened room) to aid in monitoring adequacy of ventilation is encouraged (Hart et al., 1997). The practitioner shall document the name, route, site, time of administration, and dosage of all drugs administered. The inspired concentrations of inhalation sedation agents and oxygen and the duration of administration shall be documented.

Postsedation Care

The facility and procedures followed for postsedation care shall conform to those described for moderate sedation.

Special Considerations

Local Anesthetic Agents

All local anesthetic agents are cardiac depressants and may cause central nervous system excitation or depression. Particular attention should be paid to dosage in small children (Goodson & Moore, 1983; Jastak & Peskin, 1991). To ensure that the patient will not receive an excessive dose, the maximum allowable safe dosage (e.g., mg/kg) should be calculated before administration. There may be enhanced sedative effects when the highest recommended doses of local anesthetic drugs are used in combination with other sedatives or narcotics (see Tables 2 and 3 in the original guideline document for limits and conversion tables of commonly used local anesthetics) (Goodson & Moore, 1983; Aubuchon, 1982; Fitzmaurice et al., 1990; Tipton et al., 1989; Gunter, 2002; Resar & Helfaer, 1998; Yagiela, 2004; Haas, 2002; Malamed, "Local anesthetic," 2004; Malamed, "The needle," 2004; Malamed, "Clinical action," 2004; Ram & Amir, 2006; Jakobs et al., 1995; Wright et al., 1989; Malamed, Gagnon, & Leblanc, 2000). In general, when administering local anesthetic drugs, the practitioner should aspirate frequently to minimize the likelihood that the needle is in a blood vessel; lower doses should be used when injecting into vascular tissues (American Academy of Pediatric Dentistry Council on Clinical Affairs, "Guideline on appropriate use of local anesthesia," 2005).

Pulse Oximetry

The new-generation pulse oximeters are less susceptible to motion artifacts and may be more useful than older oximeters that do not contain the updated software (Next-generation pulse oximetry, 2003; Barker, 2002; Malviya et al., "False alarms," 2000; Barker & Shah, 1996; Barker & Shah, 1997). Oximeters that change tone with changes in hemoglobin saturation provide immediate aural warning to everyone within hearing distance. It is essential that any oximeter probe is properly positioned; clip-on devices are prone to easy displacement, which may produce artifactual data (underestimation or overestimation of oxygen saturation) (Barker et al., 1993; Kelleher & Ruff, 1989).

Capnography

Expired carbon dioxide monitoring is valuable to diagnose the simple presence or absence of respirations, airway obstruction, or respiratory depression, particularly in patients sedated in less-accessible locations, such as MRI or computerized axial tomography devices or darkened rooms (Kim et al., 2003; Mason et al., 2000; McQuillen & Steele, 2000; Hart et al., 1997; Colman & Krauss, 1999; Wright, 1992; Croswell et al., 1995; Tobias, 1999; Primosch, Buzzi, & Jerrell, 2000; Roelofse, 2000; Wilson et al., 1996; Miner, Heegaard, & Plummer, 2002; Vascello & Bowe, 1999; Iwasaki et al., 1989). The use of expired carbon dioxide monitoring devices is encouraged for sedated children, particularly in situations where other means of assessing the adequacy of ventilation are limited. Several manufacturers have produced nasal cannulae that allow simultaneous delivery of oxygen and measurement of expired carbon dioxide values (Colman & Krauss, 1999; Wright, 1992). Although these devices can have a high degree of false-positive alarms, they are also very accurate for the detection of complete airway obstruction or apnea (Croswell et al., 1995; Primosch, Buzzi, & Jerrell, 2000; Iwasaki et al., 1989).

Adjuncts to Airway Management and Resuscitation

The vast majority of sedation complications can be managed with simple maneuvers, such as providing supplemental oxygen, opening the airway, suctioning, and using bag-mask-valve ventilation. Occasionally, endotracheal intubation is required for more prolonged ventilatory support. In addition to standard endotracheal intubation techniques, a number of new devices are available for the management of patients with abnormal airway anatomy or airway obstruction. Examples include the laryngeal mask airway (LMA), the cuffed oropharyngeal airway, and a variety of kits to perform an emergency cricothyrotomy.

The largest clinical experience in pediatrics is with the LMA, which is available in a variety of sizes and can even be used in neonates. Use of the LMA is now being introduced into advanced airway training courses, and familiarity with insertion techniques can be life-saving. (Berry, Brimacombe, & Verghese, 1998; Patterson, 1999). The LMA can also serve as a bridge to secure airway management in children with anatomic airway abnormalities (Selim, et al., 1999; Munro, Butler, & Washington, 1997). Practitioners are encouraged to gain experience with these techniques as they become incorporated into pediatric advanced life support courses.

An additional emergency device with which to become familiar is the intraosseous needle. Intraosseous needles are also available in several sizes and can be life-saving in the rare situation when rapid establishment of intravenous access is not possible. Familiarity with the use of these adjuncts for the management of emergencies can be obtained by keeping current with resuscitation courses, such as Pediatric Advanced Life Support and Advanced Pediatric Life Support or other approved programs.

Patient Simulators

Advances in technology, particularly patient simulators that allow a variety of programmed adverse events such as apnea, bronchospasm, laryngospasm, response to medical interventions, and printouts of physiologic parameters, are

now available. The use of such devices is encouraged to better train medical professionals to respond more appropriately and effectively to rare events (Rowe & Cohen, 2002; Medina, Racadio, & Schwid, 2000; Blike, Cravero, & Nelson, 2001)

Monitoring During MRI

The powerful magnetic field and the generation of radio frequency emissions necessitate the use of special equipment to provide continuous patient monitoring throughout the MRI procedure. Pulse oximeters capable of continuous function during scanning should be used in any sedated or restrained pediatric patient. Thermal injuries can result if appropriate precautions are not taken; avoid coiling the oximeter wire and place the probe as far from the magnetic coil as possible to diminish the possibility of injury. Electrocardiogram monitoring during MRI has been associated with thermal injury; special MRI-compatible ECG pads are essential to allow safe monitoring (Kanal, Shellock, & Talagala, 1990; Shellock & Kanal, 1996; Shellock, 2002; Dempsey, Condon, & Hadley, 2002). Expired carbon dioxide monitoring is strongly encouraged in this setting.

Nitrous Oxide

Inhalation sedation/analgesia equipment that delivers nitrous oxide must have the capacity of delivering 100% and never less than 25% oxygen concentration at a flow rate appropriate to the size of the patient. Equipment that delivers variable ratios of nitrous oxide to oxygen and that has a delivery system that covers the mouth and nose must be used in conjunction with a calibrated and functional oxygen analyzer. All nitrous oxide-to-oxygen inhalation devices should be calibrated in accordance with appropriate state and local requirements. Consideration should be given to the National Institute of Occupational Safety and Health Standards for the scavenging of waste gases (National Institute for Occupational Safety and Health, 1977). Newly constructed or reconstructed treatment facilities, especially those with piped-in nitrous oxide and oxygen, must have appropriate state or local inspections to certify proper function of inhalation sedation/analgesia systems before any delivery of patient care.

Nitrous oxide in oxygen with varying concentrations has been successfully used for many years to provide analgesia for a variety of painful procedures in children (Kennedy & Luhmann, 2001; O'Sullivan & Benger, 2003; Kennedy, Luhmann, & Luhmann, 2004; Frampton et al., 2003; Everitt, Younge, & Barnett, 2002; Krauss, 2001; Otley & Nguyen, 2000; Luhmann et al., 1999; Burton, Auble, & Fuchs, 1998; Gregory & Sullivan, 1996; Hennrikus, Shin, & Klingelberger, 1995; Hennrikus et al.,1994; Wattenmaker, Kasser, & McGravey, 1990; Gamis, Knapp, & Glenski, 1989; Kalach et al., 2002; Michaud et al., 1999; Baskett, 1972; Veerkamp et al., 1991; Veerkamp et al., 1992; Veerkamp et al., "Dental treatment. Part 3," 1993; Veerkamp et al., "Dental treatment. Part 4," 1993; Houpt, Limb, & Livingston, 2004; Shapira et al., 1992; Primosch, Buzzi, & Jerrell, 1999; McCann et al., 1996; Wilson et al., 1998). The use of nitrous oxide for minimal sedation is defined as the administration of nitrous oxide (50% or less) with the balance as oxygen, without any other sedative, narcotic, or other depressant drug before or concurrent with the nitrous oxide to an otherwise healthy patient in ASA class I or II. The patient is able to maintain verbal communication throughout the procedure. It should be noted that although local

anesthetics have sedative properties, for purposes of this guideline, they are not considered sedatives in this circumstance. If nitrous oxide in oxygen is combined with other sedating medications, such as chloral hydrate, midazolam, or an opioid, or if nitrous oxide is used in concentrations more than 50%, the likelihood for moderate or deep sedation increases (Litman et al., 1997; Litman et al., "Chloral hydrate," 1998). In this situation, the clinician must be prepared to institute the guidelines for moderate or deep sedation as indicated by the patient's response (American Academy of Pediatric Dentistry Council on Clinical Affairs, "Guideline on appropriate use of nitrous," 2005).

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

REFERENCES SUPPORTING THE RECOMMENDATIONS

References open in a new window

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of evidence supporting the recommendations is not specifically stated.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures

POTENTIAL HARMS

Sedation of pediatric patients has serious associated risks, such as hypoventilation, apnea, airway obstruction, laryngospasm, and cardiopulmonary impairment. These adverse responses during and after sedation for a diagnostic or therapeutic procedure may be minimized, but not completely eliminated, by a careful preprocedure review of the patient's underlying medical conditions and consideration of how the sedation process might affect or be affected by these conditions.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

- This revised statement reflects the current understanding of appropriate monitoring needs both during and after sedation for a procedure. The monitoring and care outlined in these guidelines may be exceeded at any time on the basis of the judgment of the responsible practitioner. Although intended to encourage high-quality patient care, adherence to these guidelines cannot guarantee a specific patient outcome. However, structured sedation protocols designed to incorporate the principles in this document have been widely implemented and shown to reduce morbidity. These guidelines are proffered with the awareness that, regardless of the intended level of sedation or route of administration, the sedation of a pediatric patient represents a continuum and may result in respiratory depression and loss of the patient's protective reflexes.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Staying Healthy

IOM DOMAIN

Safety

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

American Academy of Pediatrics, American Academy of Pediatric Dentistry, Cote CJ, Wilson S, Work Group on Sedation. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: an update. Pediatrics 2006 Dec;118(6):2587-602. [213 references] PubMed

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1992 Jun (revised 2006 Dec)

GUIDELINE DEVELOPER(S)

American Academy of Pediatric Dentistry - Professional Association
American Academy of Pediatrics - Medical Specialty Society

SOURCE(S) OF FUNDING

American Academy of Pediatrics

GUIDELINE COMMITTEE

Work Group on Sedation

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: American Academy of Pediatrics (AAP). Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. Pediatrics 1992 Jun;89(6 Pt 1):1110-5.

Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: addendum. Pediatrics 2002 Oct;110(4):836-8.

All clinical reports and policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American Academy of Pediatrics (AAP) Policy Web site.

Print copies: Available from American Academy of Pediatrics, 141 Northwest Point Blvd., P.O. Box 927, Elk Grove Village, IL 60009-0927.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on April 19, 1999. It was sent to the guideline developer for review on April 20, 1999. This summary was updated by ECRI on October 22, 2002 to incorporate information published in an addendum to the original guideline. The summary was verified by the developer on November 12, 2001. This summary was updated by ECRI on March 30, 2007. The updated information was verified by the guideline developer on April 9, 2007.

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