Reviews

Management of Children Undergoing Painful Procedures in the Emergency Department by Non-Anesthesiologists

Itai Shavit MD[1] and Eli Hershman MD[2,3]

Departments of [1]Pediatric Emergency and [2]Pediatric Intensive Care, Meyer Children's Hospital, Rambam Medical Center, Haifa, Israel
[3]Department of Anesthesiology, Rambam Medical Center, Haifa, Israel

Abstract

The treatment of acute pain and anxiety in children undergoing therapeutic and diagnostic procedures in the emergency department has improved dramatically in recent years. The availability of non-invasive monitoring devices and the use of short-acting sedative and analgesic medications enable physicians to conduct safe and effective sedation and analgesia treatment. In today's practice of pediatric emergency medicine, sedation and analgesia has been considered as the standard of care for procedural pain. In most pediatric emergency departments throughout North America, "procedural sedation and analgesia" treatment is being performed by non-anesthesiologists (qualified emergency physicians and nurses). In 2003, the Israel Ministry of Health published formal guidelines for pediatric sedation by non-anesthesiologists; this important document recognizes for the first time the need for pediatric sedation and analgesia outside the operating room. We describe the basic principles of procedural sedation and analgesia in children and urge physicians working in pediatric emergency rooms in Israel to expand their knowledge and be more involved in the treatment of pediatric procedural pain.

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Over the last few years medicine has witnessed major advances in the understanding and treatment of acute pain in children. The first step in this process was to reject previously held misconceptions that neonates, infants and children do not feel or react to pain like adults. These beliefs compounded by fears of adverse effects from sedatives and analgesic agents, and the common belief that the immature nervous system of an infant does not feel pain often resulted in the ineffective or under-treatment of acute pediatric pain. Clinical studies have clearly demonstrated that children and adults experience a similar severity of pain perception. Moreover, pain sensitivity in neonates may be even more profound than in older individuals; recent studies suggest that their nervous system may be less effective at blocking painful stimuli than those of adults [1–10]. In medical practice today, the availability of short-acting opioids and sedatives and specific drug antagonists, along with the development of new non-invasive monitoring devices and imple-mentation of safe protocols for sedation and analgesia treatment enable effective treatment for children suffering acute pain [11–15]. In today's practice of pediatric emergency medicine, sedation and analgesia are considered the standard of care for procedural pain.

Historical development

Until the early 1980s, premature infants who underwent major surgery were treated in many neonatal intensive care units with minimal anesthesia during and after the surgery, a practice that received scant criticism [1,2]. Furthermore, surveys in the 1970s and 1980s reported that infants are less likely to receive postoperative analgesics than adults [3].

In 1987, Anand and Hickey [4] published a landmark paper in the *New England Journal of Medicine* that called into question the widely held belief that neonates did not have the neurophysiologic apparatus required to experience pain. Clinical and animal studies that followed this paper indicated that neonates have a mature peripheral, spinal and supraspinal afferent pain transmission by 29 weeks of gestation, and that untreated pain has prolonged behavioral consequences [5–8]. Studies on neonatal circumcision from the late 1990s revealed that infants who were circumcised without analgesics showed increased distress during routine immunizations at age 4–6 months, as compared to uncircumcised infants or those who were pretreated with topical local anesthetic

> *Emergency room physicians in Israel need to expand their knowledge, increase their responsibility and be more involved in relieving pediatric pain and suffering*

[8]. Studies on cancer patients showed that inadequate analgesia during a first bone marrow aspiration or lumbar puncture was associated with more increased distress during subsequent procedures as compared to patients who were pretreated with oral transmucosal fentanyl citrate [8].

In 1994, Walco et al. [9] published a leading article dealing with the ethics of pain control in infants and children. They claimed that "the assessment and treatment of pain in children are important parts of pediatric practice, and failure to provide adequate control of pain amounts to *substandard and unethical medical practice* ... to meet such standards, multidisciplinary teams must develop specific treatment protocols with the goal of reducing children's pain and distress."

In September 2001, The American Academy of Pediatrics and the American Pain Society jointly issued a policy statement on the assessment and management of acute pain in infants, children and adolescents [10]. This statement provided a general definition of pediatric pain: "The concepts of pain and suffering go well beyond that of a simple sensory experience. It has emotional, cognitive and behavioral components as well as developmental, environmental and socio-cultural aspects." Furthermore, this statement emphasized the responsibility and the obligation of physicians to assess and to treat acute pain in children [10].

The need to treat pain and anxiety in children, coupled with the availability of technology allowing procedures to be done safely, led the American College of Emergency Physicians to look for specific sedation-analgesia guidelines for the emergency department. In the U.S., specialty societies and government agencies have published 12 conflicting sets of guidelines for sedation; most of them are based on the degree of sedation induced rather than the indication for sedation or the pharmacologic agent administered. Moreover, only three sedation levels were practically suitable for the pediatric age group: "conscious sedation" (AAP, 1992), "deep sedation" (AAP, 1992), and "general anesthesia" (AAP, 1992). In 1998, the ACEP published a state-of-the-art policy statement for the management of acute procedural pain and anxiety in the emergency department, defining a new entity called "Procedural Sedation and Analgesia" [11–16,19–23].

PSA refers to "a technique of administering sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardiorespiratory function. Procedural sedation and analgesia is intended to result in a depressed level of consciousness but one that allows the patient to maintain airway control independently and continuously. Specifically, the drugs, doses, and techniques used are not likely to produce a loss of protective airway reflexes." This definition is a significant improvement over the traditional AAP terminology; it accurately describes how sedation and analgesia should be practiced in the ER. In 2001, the ACEP issued an updated policy statement on pediatric sedation, emphasizing that distraction, sedation and analgesia should constitute a significant aspect of ER pediatric care [24].

Basic principles of pediatric pain assessment

[10,17,18]

Since we have all experienced pain, the evaluation is usually not considered complicated, but the provider should have some basic background in pediatrics. The ER practitioner must ask him or herself: "is this baby suffering?" In most scenarios, an experienced nurse or a physician can easily answer this question. Health providers working in emergency and trauma rooms must
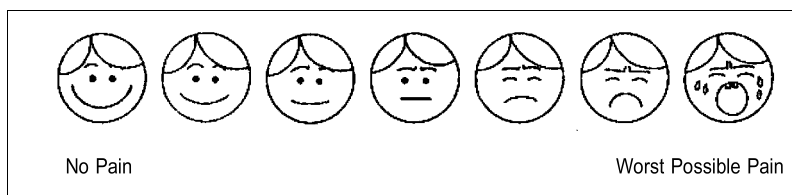
Figure 1. The Faces Pain Rating Scale

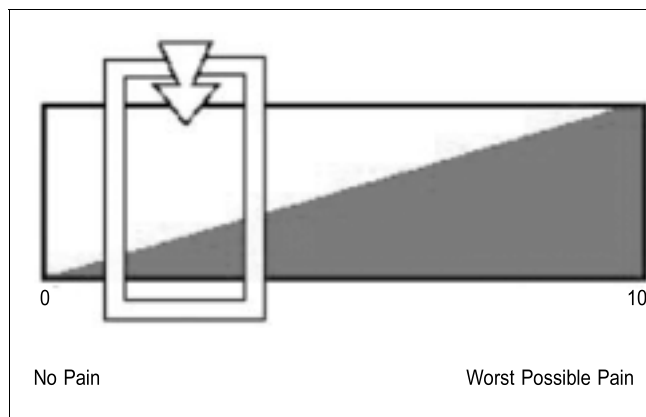No Pain   Worst Possible Pain

Figure 2. The Visual Analogue Scale

expand their knowledge and be more familiar with the principles of pediatric pain assessment. Some basic "thumb rules" are described:

● Pain is a subjective experience; therefore individual self-report is favored. Behavioral pain measures are more useful than physiologic parameters. Physiologic parameters are less reliable.

● Children younger than 8 years are not able to understand that short-term pain may have long-term benefit ("Do you want this cut to be there when you grow up?")

● Many children express distress and anxiety. Anxiety decreases the pain threshold and should be treated.

● Under the age of 2, children are unable to verbalize pain appropriately. At age 3–7 most children are competent to provide accurate information using appropriate assessment tools. For the 3–7 year age group, medical personnel should use pain assessment tools such as the "oucher scale" or the "faces pain rating scale" [Figure 1]; the Visual Analog Scale [Figure 2] can be used for children older than 8 years.

● In neonates, many assessment tools have been validated and can be used regularly; for example, the Neonatal Infant Pain Scale. In this age group, facial expression must be studied carefully for the presence of eye squeeze, brow bulge and deep nasolabial furrow. Intensity of limb movements need to be assessed as well; one or more of the following signs – pedals, toes spread, legs tensed and pulled up, agitation of arms, withdrawal reaction – suggest a high degree of pain. The infant's cry has to be evaluated for its length and intensity. When low levels of pain are present it is sometimes difficult to differentiate between pain and other causes of neonatal distress.

AAP = American Academy of Pediatrics
ACEP = American College of Emergency Physicians
PSA = procedural sedation and analgesia
ER = emergency room

Indications for PSA in the pediatric ER

Ongoing evidence continues to show the harmful effects of pain on children's behavior and development. Many children referred to the ER suffer pain, distress and anxiety. It is the pediatric emergency physician's responsibility to relieve pain and distress and to provide adequate sedation and analgesia during painful procedures, especially in fracture reduction, repair of complicated skin laceration, and debridement of amputations or burns [11–16, 19–23].

- Indications for PSA treatment in the pediatric emergency department can be divided into four categories:
- Diagnostic procedures (e.g., lumbar puncture, arthrocentesis, diagnostic imaging)
- Therapeutic procedures (e.g., laceration repair, fracture reduction)
- Vascular access (central line placement or patient with difficult intravenous access)
- Procedures in a selected patient population (e.g., psychiatric patients, mentally challenged patients, patients with special health needs) [11–16,19–23].

The three most common indications for PSA treatment in children are fracture reduction, laceration repair and diagnostic imaging (computed tomography for head trauma). The clinician's decision to perform PSA treatment has to be patient-oriented and must meet the child's needs; the child's present pain and history of pain, as well as the family support system and the coping style of the child should be considered. If the child expresses intensive pain and/or distress he or she needs to be treated immediately before initiating any other treatment (unless resuscitation is being performed) [11–16,19–23].

Principles of sedation and analgesia

Definitions

- *Sedation* is the reduction of the state of awareness; sedative drugs are used to treat distress and anxiety (e.g., midazolam).
- *Analgesia* is defined as the reduction or elimination of pain perception. Opiates (e.g., morphine, fentanyl) are the most useful for treating severe pain.
- *Amnesia* is the inability to remember an event or experience. Since every painful experience is remembered by the central nervous system and may have behavioral consequences in the future, drug-induced amnesia is very important. Most analgesics have some sedative effects but many sedatives lack any analgesic effect. Benzodiazepines (such as midazolam) provide sedation only. Many sedative drugs are also amnesic (e.g., midazolam, ketamine) [11,12,19–25]. A detailed pharmacopoeia is beyond the scope of this review.

Continuum of sedation

Sedation comprises a continuum of states ranging from minimal sedation (anxiolysis) through general anesthesia. The progression from mild sedation to moderate sedation, deep sedation and general anesthesia cannot be easily divided into discrete stages. As the dose of the drug administered increases and the drug level in the central nervous system rises, consciousness decreases and the risk of cardiorespiratory depression increases [11,12]. This progression is not drug-specific since it can be achieved with essentially all medications depending on the dose and the route used. A major principle that must be remembered is that the level of sedation produced will vary from patient to patient depending on the painful stimulus before and during the procedure and the level of distress and anxiety; a dose of sedative that is inadequate to induce any sedation in one patient may render another patient deeply unconscious [25].

There are several definitions to describe the levels of sedation; the American Society of Anesthesiologists has defined four levels [Table 1]:

- *Minimal sedation* (anxiolysis): the child responds normally to verbal stimulation; cognitive function and coordination are mildly impaired but cardiorespiratory function, spontaneous ventilation and airway reflexes are unaffected.
- *Moderate (conscious) sedation*: cognitive function and coordination are impaired but the child responds purposefully to verbal stimulation, either alone or with tactile stimulation. Cardiorespiratory function is usually maintained and ventilation is adequate. The patient maintains airway reflexes, and intervention to maintain patent airway is usually not indicated.
- *Deep sedation*: the child cannot be easily aroused but responds purposefully to repeated or painful stimuli. The ability to maintain spontaneous ventilation and airway reflexes may be inadequate and the patient may require assistance in ventilation and in maintaining patent airway. Cardiorespiratory function is usually maintained.
- *General anesthesia*: the child cannot be aroused with verbal commands or tactile stimulation and there is a high risk for the loss of protecting reflexes and inability to maintain

Table 1. Continuum of depth of sedation. Definitions of general anesthesia and levels of sedation (American Society of Anesthsiologists)

Level of sedation	Mimimal sedation (anxiolysis)	Moderate sedation (conscious sedation)	Deep sedation	General anesthesia*
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response following repeated or painful stimulation	Unarousable, even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

* To be performed by anesthesiologist only.

spontaneous ventilation. General anesthesia should only be performed by a qualified anesthesiologist (non-anesthesiologists are not qualified and are forbidden to perform general anesthesia) [11,12,25].

Non-pharmacologic approach

It is preferred that the patient and his/her parents be placed in a quiet and isolated room in the ER prior to the procedure. Distraction techniques by parents can be very helpful and parents should be encouraged to use them [17]. The pharmacologic approach takes into account the type of procedure to be performed and the anticipated intensity and duration of expected pain. Both the child and the caregivers should receive information about what to expect and appropriate preparation on how to minimize distress. It is advisable to have at least one parent present during the procedure in order to help the child cope with pain and to reduce anxiety [11,12].

Drug-selection strategies

There are various drug-selection strategies for PSA treatment depending on the type of procedure, and the patient's age, history and other patient-related factors. If the child is cooperative, many minimally invasive procedures can be performed without any sedation (distraction techniques only), or using minimal sedation (anxiolysis) or moderate sedation. However, when the procedure is painful (e.g., fracture reduction) or when there is a considerable amount of distress and anxiety (young children), successful and humane practice may require intentional deep sedation. Such sedation can be performed by anesthesiologists, or qualified emergency or intensive care physicians experienced in pediatric airway management [11–16,19–23]. A detailed description of various drugs used for PSA is beyond the scope of this review.

PSA treatment by non-anesthesiologists

Personnel

Only qualified medical personnel who are well trained in airway management, pediatric advanced life support, and sedation, should administer PSA treatment. These persons should be experienced in the treatment of cardiorespiratory complications, including respiratory depression, apnea, partial airway obstruction, emesis and hypersalivation, and familiar with the pharmacodynamics and pharmacokinetics of sedation medications. At least two persons should be assigned for each procedure, one of them qualified in PSA treatment (usually two physicians, but in certain circumstances a physician and a qualified nurse). The ER nursing staff has an important role; monitoring should be performed by designated personnel trained in identification and management of complications [11–16,19–25].

Resuscitation equipment

PSA treatment can be administered only in a department where a fully equipped resuscitation space is available. All age-related resuscitation equipment should be present and must be checked regularly, including bag-valve masks, oxygen, suction, and endo-

tracheal tubes. Only a department that meets these criteria can be considered a "safe environment" for PSA [11–16,19–25].

Accepted protocol and recording

A written PSA protocol should always be used; it is preferred that this protocol be designed by an experienced pediatric emergency physician and reviewed and fully accepted by all relevant hospital disciplines: anesthesiologists, surgeons, and intensive care specialists.

Documentation and recording should be done for each procedure before, after, and during the procedure. All relevant data including vital signs and medications are recorded and the document has to be signed by the physician responsible for the PSA. Discharge criteria will be recorded before the patient leaves the department [11–16,19–25].

Before the procedure an informed consent form should be provided by the child's caregiver; this medico-legal issue has to be taken into consideration. In most U.S. states, oral informed consent is legally accepted for an emergency procedure such as fracture reduction, laceration repair or lumbar puncture.

Pre-sedation evaluation [11–16,19–25]

It has been shown that an appropriate pre-sedation assessment reduces complications of sedation [26]. A focused history-taking and physical examination should precede sedation. The history should include underlying medical problems, medication use, medication allergies, previous surgery or sedation, any adverse reaction to sedation in the past, last oral intake, and events leading to the procedure. The physical examination should be directed to the upper airway (pharynx structures, mandible position and size, neck flexion), and full cardiopulmonary assessment. According to the guidelines of the American Society of Anesthesiologists, only children classified as ASA I or ASA II should be included [Table 2]. The recommended ASA guidelines for duration of fasting before elective procedures vary with age. However, the guidelines acknowledge the fact that there are insufficient data to test the assumption that pre-procedure fasting results in a decreased incidence of adverse outcomes. The risks and benefits must be assessed for each patient by balancing the potential for vomiting and aspiration with the timing and urgency of the procedure and the depth of the sedation required. A recent study by Agrawal at el. [27] did not show any association between pre-procedural fasting state and adverse events.

Monitoring [11–16,19–25]

The most important element of monitoring during sedation is close, continuous observation of the patient. The designated person must continuously observe the child's face and mouth and the motion of the chest wall. Patients moderately or deeply sedated should be continuously monitored by pulse oximetry and electrocardiography. At a minimum, vital signs should be checked at baseline, after the administration of the drug, on completion of the procedure, during early recovery, and at completion of recovery. When sedation is administered by the oral, nasal or rectal route, intravenous access is not mandatory. However, the intravenous route should be used for

Table 2. Physical status classification of the American Society of Anesthesiologists

Class	Description	Examples	Suitability for sedation
1	Normally healthy patient	Unremarkable medical history	Excellent
2	Patient with mild systemic disease (no functional limitations)	Mild asthma, controlled seizure disorder, controlled diabetes mellitus	Generally good
3	Patient with severe systemic disease (definite functional limitation)	Moderate to severe asthma, poorly controlled seizure disorder, poorly controlled diabetes, moderate obesity	Intermediate to poor; consider benefits relative to risks
4	Patient with severe systemic disease that is a constant threat to life	Severe bronchopulmonary dysplasia, sepsis, and advanced degree of pulmonary, cardiac, renal, hepatic or endocrine insufficiency	Poor, benefits rarely outweigh risks
5	Moribund patient who is not expected to survive without the operation	Septic shock, severe trauma	Extremely poor

deeper levels of sedation or anticipated administration of multiple doses.

Discharge criteria [11–16,19–25]

All patients must be monitored until they are no longer at risk for cardiorespiratory depression. Before discharge, children should be alert and oriented (i.e., have returned to the age-appropriate baseline). Vital signs should be stable and at baseline levels. It is recommended that written instructions be given to the child's caregiver.

Practicing PSA in Israel

The ER is a unique environment where a variety of patients with emergent and urgent conditions are managed. Many of these conditions result in significant pain and are associated with varying degrees of anxiety, making the management of analgesia and sedation a primary concern for the emergency physician. In North America, the development of pediatric emergency medicine as a unique subspecialty has made procedural sedation a fundamental skill expected of any specialist in this field. It is expected that a pediatric emergency physician working in an ER will practice procedural sedation as an integral part of his/her scope of practice. Due to this focus on the pediatric emergency physician as an individual capable of providing a high level of acute care, pediatric emergency departments throughout the U.S. and Canada are making safe and efficacious use of procedural sedation and analgesia around the clock [28].

In Israel, many pediatricians and surgeons working in emergency and trauma rooms are not familiar with the principles of PSA in children. The management of acute pain and anxiety in children undergoing therapeutic and diagnostic procedures in the ER is sometimes less than optimal, especially during the busy hours when an anesthesiologist cannot be available on an urgent basis. This situation is associated with increasing pain and suffering, and there have been some documented cases in which children suffering from an unstable displaced fracture were treated by fracture reduction using inappropriate analgesia and no sedation. In other cases, face lacerations were sutured while the anxious child was being held forcefully by ER personnel because no sedation was used.

In May 2003, the Israel Ministry of Health published formal guidelines for pediatric sedation by non-anesthesiologists [29]. This document should be regarded as a landmark paper because it recognizes the need for PSA treatment outside the operating room for the first time. The Ministry of Health position paper will hopefully become a first step towards implementation of PSA treatment protocols in Israeli pediatric emergency departments; it also recommends the establishment of a pediatric sedation course for non-anesthesiologists – an important initiative that may encourage ER physicians to improve their skills and knowledge through this training.

It is a priority for all clinicians to improve their knowledge and skills in treating pediatric procedural pain and suffering. The authors of this article call physicians working in pediatric emergency rooms to increase their responsibility and involvement in the treatment of pediatric procedural pain.

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Correspondence: Dr. I. Shavit, Dept. of Pediatric Emergency, Meyer Children's Hospital, Rambam Medical Center, P.O. Box 9602, Haifa 31096, Israel.
Phone: (972-4) 854-2522
Fax: (972-4) 854-3109
email: i_shavit@rambam.health.gov.il