Abstract:
The spectrum of sedative and analgesic agents available to those who provide pediatric sedation and analgesia in the emergency department has broadened considerably over the past 2 decades. Pharmacologic agents that can be used alone or in combination in this context include nitrous oxide, midazolam, chloral hydrate, pentobarbital, etomidate, dexmedetomidine, propofol, and ketamine. The pharmacology, common clinical uses, advantages, and disadvantages of each of these agents are reviewed. Pharmacokinetics of the agents is addressed in tabular form, whereas pharmacodynamic aspects of each agent are discussed in more detail. Clinical uses addressed include noninvasive as well as invasive procedures. Relevant studies involving comparison of various sedative regimens for common emergency department procedures are reviewed.

Keywords:
procedural sedation; analgesia; pediatrics; chloral hydrate; dexmedetomidine; etomidate; ketamine; midazolam; nitrous oxide; pentobarbital; propofol

Jefferson Medical College, Philadelphia, PA; Nemours/A.I.duPont Hospital for Children, Wilmington, DE.
Reprint requests and correspondence: Susanne Kost, MD, Nemours/A.I.duPont Hospital for Children, 1600 Rockland Rd, Wilmington, DE 19899.
skost@nemours.org

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Procedural Sedation and Analgesia in the Pediatric Emergency Department: A Review of Sedative Pharmacology

Susanne Kost, MD, Anita Roy, MD

The spectrum of agents available for pediatric procedural sedation and analgesia (PSA) in the emergency department (ED) has broadened considerably over the past 2 decades. The intramuscular narcotic-phenothiazine "cocktail" has been relegated to historical lore, and the present-day practitioner can choose from over a dozen pharmacologic options, enabling some finesse in matching the sedative-analgesic agents and routes of delivery to fit the clinical need.[1,2] The procedural sedation pharmacopeia can be divided into 4 main categories: pure analgesic, sedative-hypnotic, dissociative, and inhalational. The analgesics can be divided into opioid and nonopioid, and the sedative-hypnotic category can be further subdivided into benzodiazepines, barbiturates, and others (Figure 1). The agents can be used alone or in combination, further

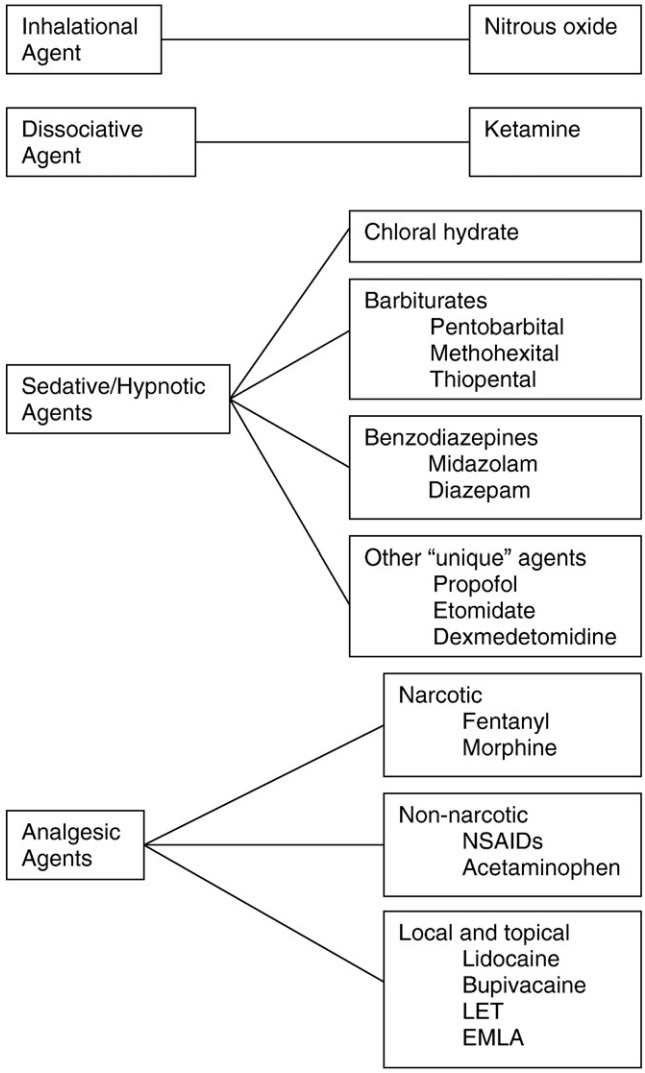

Figure 1. Pharmacopeia for procedural sedation and analgesia. EMLA - eutectic mixture of local anesthetic; LET - lidocaine, epinephrine, tetracaine; NSAIDs - nonsteroidal anti-inflammatory agents.

broadening the options for alleviating procedural pain and distress.

This article will review the pharmacology and clinical indications for commonly used sedative agents in present-day pediatric emergency medicine. Pharmacokinetics (how the body metabolizes the drug, including onset and duration) will be outlined in Table 1; the text will focus on sedative pharmacodynamics (how the drugs affect the patient), the common indications, and the advantages and disadvantages of each agent.

NITROUS OXIDE

Nitrous oxide (NO) is a gas that produces mild to moderate levels of analgesia, sedation, and dissociation when inhaled in concentrations of 30% to 70%.[3] Nitrous is administered with oxygen via 1 of 2 types of delivery systems, either fixed concentration (usually a 50:50 mixture) or titratable. The delivery system must include a scavenging mechanism to collect excess gas. Newer continuous-flow delivery systems alleviate the problem of the demand-valve mask, common in early systems designed for adult patients, which made use in the younger population difficult due to the inability to generate sufficient negative inspiratory pressure to open the valve. Systems with full face mask capability as compared to nasal hood only also expand the options for use in younger and less cooperative patients.

Nitrous oxide has been used in dental care settings for decades, and it has been recently undergoing a slow but steady increase in popularity for alleviating pain and distress for a variety of minor