



KEY ADVANCES PRACTICE ADVANCE

Procedural Sedation for Children in the Emergency Department

New July 2024

Why is this topic important? Children who require care in our emergency departments (EDs) across the country often require interventions to mitigate their anxiety and pain. Fortunately, this can often be done with simple strategies like using developmentally appropriate attention-focusing techniques or even oral or intranasal analgesic or anxiolytic medications. There are situations, however, in which a greater degree of pain and anxiety control is required. Procedural sedation (PS) is appropriate to help provide optimal care for children when these situations are encountered and is commonly performed safely in EDs. There are several options for medications to perform PS, with variable benefits and adverse event rates. Despite the frequency of PS in children, there is still a relative paucity of high-quality data to guide best practices.

How will this change my clinical practice?

The development of protocols to guide the best practices for pediatric PS can ensure that PS be performed safely and effectively in the ED. This Practice Advance Synopsis can assist in the development of these local and regional protocols.

Synopsis Focus Points:

1. **Pediatric PS in the ED is generally safe**, with clinically important adverse events being uncommon. The most common severe respiratory complication is laryngospasm (approximately 1/250 sedations), which occurs almost exclusively with ketamine or ketamine/propofol. Vomiting is the most common minor adverse event, occurring in 5-6% of cases.
2. **There is no perfect medication to use for PS for all children in all scenarios.** Several safe and effective options are available and include propofol, ketamine, ketamine-propofol combination, etomidate, midazolam, dexmedetomidine, and nitrous oxide. Clinicians may choose medications based on availability of the options, their experience with individual medications, as well as patient-specific factors. There is no evidence that one of these agents is consistently superior to others.
3. **Ketamine-propofol combination is a reasonable option** for pediatric PS, but has not shown consistent superiority over other options, particularly propofol alone.
4. **Capnography may allow earlier detection of hypoventilation** during PS but has not been shown to decrease meaningful adverse events.

5. **Pre-sedation ondansetron has not consistently been shown to reduce post-sedation vomiting.**

Background:

Safety and adverse events: A systematic review of almost 14,000 pediatric sedations performed in the ED since 2004 showed a low rate of serious adverse events.(1) Aspiration and need for intubation were extremely rare (< 0.05% or 1/2000). Laryngospasm occurred in approximately 0.4% or 1/250, and almost exclusively with the use of ketamine, with or without concurrent propofol. The most common minor adverse event was vomiting (approximately 5.6%), which was most frequent with ketamine. The next most common adverse events were agitation (1.8% total and most frequent with midazolam); hypoxia (1.5% overall and most frequent with etomidate); and apnea (0.7% overall and most frequent with ketamine-propofol combination). **Overall, these data point to the safety of pediatric PS performed in the ED when performed by experienced emergency physicians with adequate resources.**

Medication Choice: There are several common medications used for pediatric PS in the ED. Each may have its own set of advantages and risks compared to others. Recently, a large meta-analysis including 23 pediatric studies and seven studies that had both adults and children demonstrated several medication options that had favorable outcomes compared to midazolam-opioids.(2) Sedation recovery time is shorter with propofol, patient satisfaction is better with ketamine-propofol combination, and respiratory adverse events are less common with ketamine alone. The selection of medication should take into consideration the potential risk for adverse events, as each medication has its own specific risk profile. Each of the most common adverse events in the systematic review by Bellolio et al had a different agent associated with the highest frequency of that event.(1) Several smaller randomized studies comparing efficacy and adverse events between several of these different agents, however, have yielded inconsistent results.(3-6) The sedation plan must also account for what is available to the individual providers, as some agents, such as nitrous oxide and dexmedetomidine, may not be widely available for PS in the ED setting. Any of the aforementioned options may be reasonable choices for pediatric PS in the ED. Of note, the 2014 ACEP Clinical Policy for Procedural Sedation and Analgesia states that **ketamine and propofol can be safely administered to children for PS in the ED (Level A recommendation). The combination of ketamine and propofol receives a Level B recommendation, while etomidate receives a Level C recommendation.**(7)

Ketofol or ketamine-propofol combinations: Ketamine-propofol combination offers several theoretical advantages over single agent ketamine or propofol, as the unwanted effects of each medication may offset each other. Ketamine may minimize the potential for apnea or hypotension with larger doses of propofol alone, for example. The combination of the two drugs should also allow for smaller doses of each medication, potentially allowing for shorter recovery time. Trials comparing the combination of ketamine and propofol to other agents, however, have not consistently confirmed a clinically meaningful advantage.(3,4,8) A 2020 systematic review (11 trials comprising 1274 patients) found no difference between the combination of ketamine and propofol and the solo agents with respect to development of apnea, desaturation, vomiting, satisfaction, or any other adverse events. There was, however, an approximately 10-minute shorter time to recovery with the ketamine-propofol combination.(8) **The combination of ketamine and propofol is a reasonable option for pediatric PS in the ED, but likely offers little to no meaningful advantage over ketamine or propofol alone.**

Capnography: During PS, the most common potentially serious adverse events are related to ventilation and oxygenation. Capnography allows for earlier detection of apnea and may allow the

treating clinician to intervene or alter the sedation earlier, which theoretically decreases the risk of eventual hypoxia, need for more aggressive interventions, or even intubation. Evidence from randomized trials that demonstrate a clinically important benefit is, however, lacking in both adults and children. A 2017 Cochrane review comprising only three ED trials concluded “There is a lack of convincing evidence that the addition of capnography to standard monitoring in ED PSA [procedural sedation and analgesia] reduces the rate of clinically significant adverse events.”(9) Of the three included trials, one was in children, and did not demonstrate a difference in desaturations or respiratory interventions between the capnography and control groups.(10) **Capnography may allow for earlier detection of apnea and hypoventilation and, given the low potential for harm, should be encouraged where available, but is not mandatory to perform safe pediatric PS in the ED.**

Ondansetron: At least four randomized trials have been performed to evaluate the efficacy of pre-sedation ondansetron to prevent post-sedation vomiting in children.(11-14) In three trials, the sedation agent was intramuscular or intravenous ketamine,(12-14) and in the fourth, the agents were fentanyl and nitrous oxide.(11) There was no effect in the nitrous oxide study or the largest, open-label (n = 237) ketamine study.(11,12) Two smaller, double-blind, ketamine studies (n = 111 and 127) found a decrease in post-sedation vomiting with ondansetron administration (9% vs 22% in one study and 5% vs 13% in the other).(13,14) Given the inconsistent results, **we conclude ondansetron pre-treatment is reasonable for ketamine sedations, but likely of only modest benefit at most.**

References:

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Notes: Practice Advance synopses should be built from a strong body of evidence, that likely includes a systematic review. The synopsis will include a recommendation that should be similar in wording to how GRADE recommendations are given. These should not be controversial recommendations and essentially all emergency physicians should be adopting them. The impact or “effect size” should be substantial and no significant harm should be associated with this gain.

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