The ability to administer procedural sedation and analgesia (PSA) is a necessity for today's emergency physician (EP), and the list of indications for its use have grown over the years. The quest to determine the safest, most efficacious method continues, producing ongoing research on sedation techniques both old and new. This edition of “Resident Journal Review” focuses on selected updates on familiar agents and investigations into novel regimens over the past two years. For detailed discussion of the individual articles please see the full article that can be found on MedScape. Presented here is a listing of the articles reviewed and the take home points that we feel are important knowledge for all EPs.

Propofol
Since being first identified in 1996 by Swanson and colleagues as an agent suitable for aiding in completion of brief-yet-painful and anxiety-provoking procedures, propofol’s use has increased significantly and is now one of the most popular sedative agents in the emergency department (ED). It has a short onset and duration of action, with no active metabolites, making it ideal for use in the ED setting. Its adverse effects include nausea, vomiting, hypotension, pain on infusion, over-sedation, respiratory depression and the potential for respiratory arrest. Despite this side effect profile, recent studies confirm the ability to administer propofol safely for procedural sedation and provide appropriate dosing in a variety of age groups.

Articles and Take Home Points:
- Propofol is safe for procedural sedation in emergency departments. Emergency physicians should be prepared with intravenous fluids and airway maneuvers in case of hypotension or hypoxia, although these are infrequently necessary.

- The effective induction dose in pediatrics appears to be inversely proportional to age with a mean dose of 2.1mg/kg; in particularly young patients it is advisable to keep a need for higher dosing in mind but to start low and titrate upward.

- Propofol usage, at decreased dosages, is safe in elderly patients >65 years. There may be an increased chance of hypotension in older patients, so providers should be prepared to give intravenous fluids if needed.

Etomidate
Favored for its neutral hemodynamic profile, etomidate is often used to facilitate procedures in patients who are hypotensive or without hemodynamic reserve when the procedure is expected to be short in duration. There have been several studies in adult populations, but few prospective studies regarding etomidate use and safety in children.

- When using etomidate with concomitant opiates for analgesia in pediatric procedural sedation, providers may start with a dose of 0.2mg/kg and monitor patients closely for adverse respiratory events.

Ketamine
Ketamine has become a popular agent in PSA due to its combination sedative-dissociative-anesthetic properties. It has a rapid onset of action although slightly longer half-life than other agents, and is an attractive agent in patients who are at risk for hypotension due to its chronotropic and inotropic effects that help maintain their cardiovascular status. Its use has generally been avoided, however, in patients with suspected eye injuries due to reports that it might increase intraocular pressure (IOP), which has been controversial in recent literature.

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Articles and Take Home Points:


- Ketamine does not appear to result in clinically significant elevations in intraocular pressure in pediatric patients without eye injury.


- Intranasal administration of ketamine of 9mg/kg can produce adequate sedation in children, but more research is needed to fully test its use and determine the optimal dosage for both safety and efficacy.

Ketofol

Because of their opposing effects on respiratory drive and hemodynamics, concurrent use of propofol with ketamine (“ketofol”) for sedation has also become an increasingly common tool for procedural sedation, and its use has been supported by preliminary data in ED and OR settings. Recently, three randomized, prospective trials have compared ketofol with other standard regimens for procedural sedation.

Dexmedetomidine (Precedex®)

Dexmedetomidine (Precedex®) is an alpha-2 adrenergic agonist that causes central nervous system (CNS) mediated sedation without affecting the respiratory drive. It is, however, limited by occasional hypotension and bradycardia. With shortages of common medications for procedural sedation presently looming, dexmedetomidine may be an increasingly available option in some emergency departments. There are no prospective studies or retrospective reviews of dexmedetomidine in emergency medicine journals, but its use in procedural sedation has been evaluated in other settings and we include some pertinent publications here.


- Dexmedetomidine has been reported to successfully facilitate tolerance of noninvasive positive pressure ventilation and thereby avoid the need for intubation in asthmatic respiratory distress.


- It is unclear whether dexmedetomidine has a more or less favorable efficacy or safety profile compared to midazolam, but it appears to be an effective sedation agent for PSA.

Dexmedetomidine for procedural sedation results in higher minimum oxygen saturations than benzodiazepines during particular procedures but may have a higher rate of bradycardia, the clinical significance of which is uncertain.

Novel Opioids (Alfentanil & Remifentanil)
Alfentanil is an opioid that induces sedation and anesthesia with a duration of action similar to propofol. It has no amnestic properties, and its side effects include skeletal muscle rigidity, hypotension, bradycardia, and respiratory depression. Remifentanil is a synthetic opioid analgesic with a therapeutic potency similar to that of fentanyl. It is rapidly hydrolyzed in the blood and therefore has a very short half-life with less accumulation. It also does not relax skeletal muscle, and its primary side effects are respiratory depression, nausea, bradycardia and pruritis. There have been scant publications regarding use of these agents for procedural sedation in EDs over the past decade, and many EPs remain unfamiliar with their use.

Additional Resources:

Articles and Take Home Points:
• Remifentanil has a very short duration of action and shows promise as a hemodynamically stable analgesic, although may need concomitant treatment with anxiolytics and/or muscle relaxants depending on the procedure.

• Alfentanil appears to be efficacious and provides patient satisfaction, but has an adverse event rate similar to that of sedatives providing deeper sedation, and is associated with subclinical respiratory depression as evidenced by capnography.

Capnography in Procedural Sedation
While several studies, including some reviewed here, have utilized capnography and ETCO₂ measurements in evaluating for respiratory depression, this monitoring parameter has not yet been defined as standard of care in emergency department procedural sedation.


• There is still not enough strong evidence to make an overarching recommendation for or against standard utilization of capnography monitoring during PSA. Further research comparing its use in groups with and without supplemental preoxygenation might be helpful. Until further data is available, it seems reasonable to use capnography in situations where preoxygenation is provided, so as not to miss respiratory depression masked by O₂ supplementation. In healthy populations not receiving supplemental oxygenation, pulse oximetry is an effective predictor of impending hypoxic respiratory failure.