

Table 4. Commonly used medications in procedural sedation and analgesia

Analgesic-Sedatives					
Drug	Dose	Onset (minutes)	Duration (minutes)	Indications	Considerations
Fentanyl	IV: 1-2 mcg/kg Titrate 1 mcg/kg q3-5 minutes prn IN: 2 mcg/kg Nebulized: 3 mcg/kg	IV: 1-5 IN: 1-5 Neb: 1-5	IV: 30-60 IN: 30-60 Neb: 30-60	Brief invasive procedures, especially in combination with a benzodiazepine or propofol	Use lower dose if combining with benzodiazepines Chest wall rigidity possible if IVP, especially in neonates; for IN administration, maximum volume 1 mL/naris
Morphine	IV: 0.05-0.15 mg/kg titrated to max 3 mg/kg	IV: 5-10	IV: 120-180	Longer invasive procedures; orthopedic pain	Use lower dose if combining with benzodiazepines
Ketamine	IN: 0.5-1 mg/kg (for sub-dissociative pain control only)	IN: 3-5	IN: 30-60	Primary, adjunct, or rescue pain control	Verify ketamine concentration (multiple concentrations available)

NB: These dosing regimens are provided for general reference; please consult your local institutional policy manual and preferred drug reference handbook. Each clinical presentation is unique. Dosing may be altered depending on the patient's characteristics, comorbidities, clinical status, and the practitioner's experience with these medications. Individual dosages may vary especially when used in combination with other medications, such as when benzodiazepines are co-administered with opioids.

Adjunct Anxiolytic-Sedatives					
Drug	Dose	Onset (minutes)	Duration (minutes)	Indications	Considerations
Midazolam	IV: (< 5 years old) 0.05-0.1 mg/kg, titrated to max 0.6 mg/kg IV: (> 5 years old) 0.025-0.05 mg/kg, titrated to max 0.4 mg/kg IM: 0.1-0.2 mg/kg IN: 0.2-0.5 mg/kg PO: 0.5-0.75 mg/kg PR: 0.25-0.5 mg/kg	IV: 1-2 IM: 5-20 IN: 10-15 PO: 15-30 PR: 10-30	IV: 15-30 IM: 60-120 IN: 15-60 PO: 60-90 PR: 60-90	Distressful procedures Painful procedures with an analgesic, typically fentanyl	Works well with opioids Children may become disinhibited, or complain of dizziness For IN administration, maximum volume 1 mL/naris
Nitrous oxide	Through flow meter or fixed concentration: 70% O ₂ /30% N ₂ O (min) 50% O ₂ /50% N ₂ O (avail as fixed) 30% O ₂ /70% N ₂ O (max)	Inhaled: 3-5	Inhaled: 3-5	Brief distressful procedures such as injections, IV placement, Foley catheter placement	Via a “demand valve” mask which requires negative pressure to activate Minimum age for demand valve mask use is generally 5 years; has some analgesic properties

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Adjunct Hypnotic-Sedatives					
Drug	Dose	Onset (minutes)	Duration (minutes)	Indications	Considerations
Dexmedetomidine	IV: initial load – 1-2 mcg/kg over 10 minutes; then 0.5-1 mcg/kg per hour IN: 1-2 mcg/kg	IV: 5-10 IN: 10-30	IV: 30-70 IN: 30-60	Non-invasive procedures, such as CT, MRI, EEG	Watch for bradycardia; may see initial hypertension. Anecdotal advantage in children with autism. For IN administration, maximum volume 1 mL/naris
Etomidate	IV: 0.1 mg/kg; may repeat if response inadequate	IV: < 1	IV: 5-15	Non-invasive procedures, such as CT; may be used with fentanyl for brief painful procedures, such as fracture reduction/dislocation	Provides immediate, deep sedation; myoclonus may occur; controversial in septic patients
Methohexital	IV: 0.5-1 mg/kg	IV: 3-5	IV: 15-30	Non-invasive procedures, such as CT	Deep sedation; watch for respiratory depression
Pentobarbital	IV: Initial dose 1-2 mg/kg; titrate with 1-2 mg/kg increments to max of 6 mg/kg	IV: 3-5	IV: 15-45	Non-invasive procedures, such as CT, MRI	May see paradoxical excitement/agitation, especially in younger children
Propofol	IV: 1 mg/kg; titrate with additional 0.5 mg/kg aliquots	IV: < 1	IV: 5-15	Non-invasive procedures; invasive procedures with addition of analgesic	Watch for hypotension and respiratory depression; avoid in egg and soy allergies

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Dissociative Analgesic-Sedative					
Drug	Dose	Onset (minutes)	Duration (minutes)	Indications	Considerations
Ketamine	IV: 1-1.5 mg/kg; may repeat the dose every 10 minutes as necessary	IV: 1	IV: 15; recovery may take 30-60	Invasive procedures; distressful procedures	Expect deep sedation; explain to parents that nystagmus is normal and that child may appear more alert than in reality. Mild amnestic, analgesic; may be cause nausea on awakening. Contraindicated in children less than 3 months of age, history of tracheal stenosis, increased ICP or IOP

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Rescue agents					
Drug	Dose	Onset (minutes)	Duration (minutes)	Indications	Considerations
Atropine	IV: 0.02 mg/kg	IV: < 1	IV: 5-10	Hypersalivation in ketamine administration; bradycardia not improved with optimizing respiratory status	Minimum dose is 0.1 mg Maximum dose is 0.5 mg for hypersalivation or symptomatic bradycardia
Flumazenil	IV: 0.02 mg/kg/dose; may repeat every minute to max of 1 mg	IV: 1-2	IV: 30-60	Benzodiazepine reversal	Do not use with children with seizure disorder or anyone with chronic benzodiazepine use; central-acting antagonist - potential subsequent seizures will be refractory to benzodiazepines
Naloxone	IV: 0.1 mg/kg/dose to maximum 2 mg/dose; may repeat every 2 minutes as needed IM: 0.1 mg/kg/dose to maximum 2 mg/dose; may repeat every 2 minutes as needed	IV: 2 IM: 10-15	IV: 20-40 IM: 60-90	Opioid overdose with persistent respiratory depression	If drug to be reversed is longer-acting, then will need to repeat dose, or start a drip
<i>Note: Always optimize respiratory status first. Initiate Pediatric Advanced Life Support if the above medications do not resolve the problem immediately. Be sure to have bag-valve mask ventilation and rapid sequence intubation equipment and medications in the room, ready for use.</i>					

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